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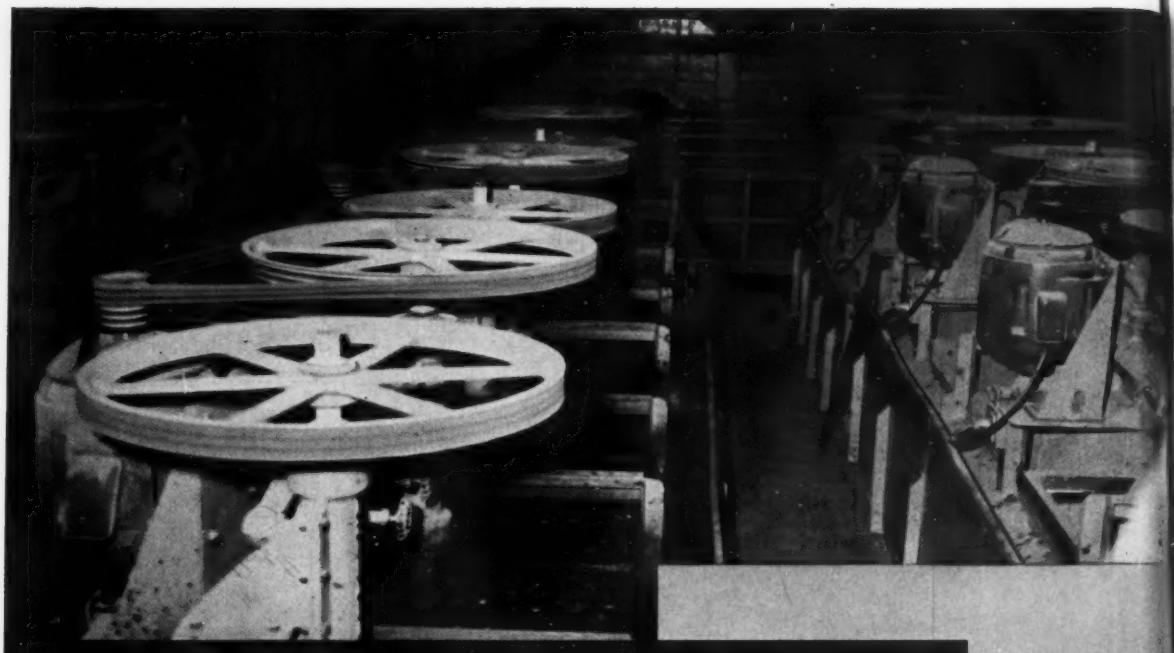

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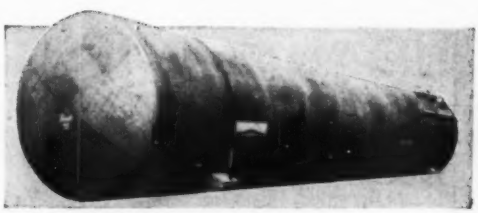

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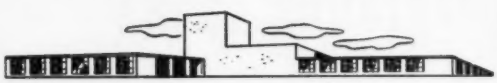

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THE TABULAR VIEW

Arts Colleges. — No regular reader of The Review needs to be reminded that schools of science and engineering are unable to supply the current demand for technically competent personnel. Nor do they need to be refreshed as to the desirability of flavoring a professional technical education with a bit of "the humanities." But are the students of the liberal arts colleges merely "executing intellectual minuets" as has been said? And what is the role of the liberal arts college — especially the small one — in equipping today's youth to cope with a world of jet propulsion and television? This problem is discussed (page 137) by JAMES STACY COLES who in 1952 assumed the presidency of Bowdoin College after a career of teaching and research in chemistry. The combined program of a liberal arts training supplemented by science and engineering, which Bowdoin and M.I.T. operate, gives ample proof of Dr. Coles's contention that a liberal arts training is as necessary for the well-educated man of today as a background in science. President Coles received the B.S. degree from Pennsylvania State Teachers College in 1934; from Columbia University he received the A.B., A.M., and Ph.D. degrees in 1936, 1939, and 1941, respectively. He taught chemistry at the College of the City of New York (1936-1941), Middlebury College (1941-1943), and Brown University (1946-1952). During World War II, Dr. Coles was supervisor of the Underwater Explosives Research Laboratory at Woods Hole, Mass. His article in this issue of The Review is a pleasant sequel to a luncheon meeting at the Faculty Club in November at which the role of the small liberal arts college was unfolded before members of the M.I.T. Faculty.

Brook Farm. — Vociferous proclaimers that ideal conditions for man's welfare are provided by the socialistic or communal state can point out that the Pilgrims practiced a form of communism, and that a number of settlements for socialized living were operating in the United States about a century ago. Some of these colonies were established by well-educated, well-meaning, high-principled — even idealistic — individuals, yet none of them survived. One of the most promising experiments in socialized living was the settlement at Brook Farm, in what

(Concluded on page 128)

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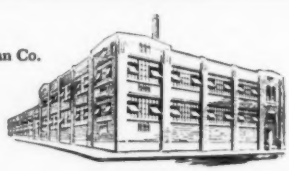

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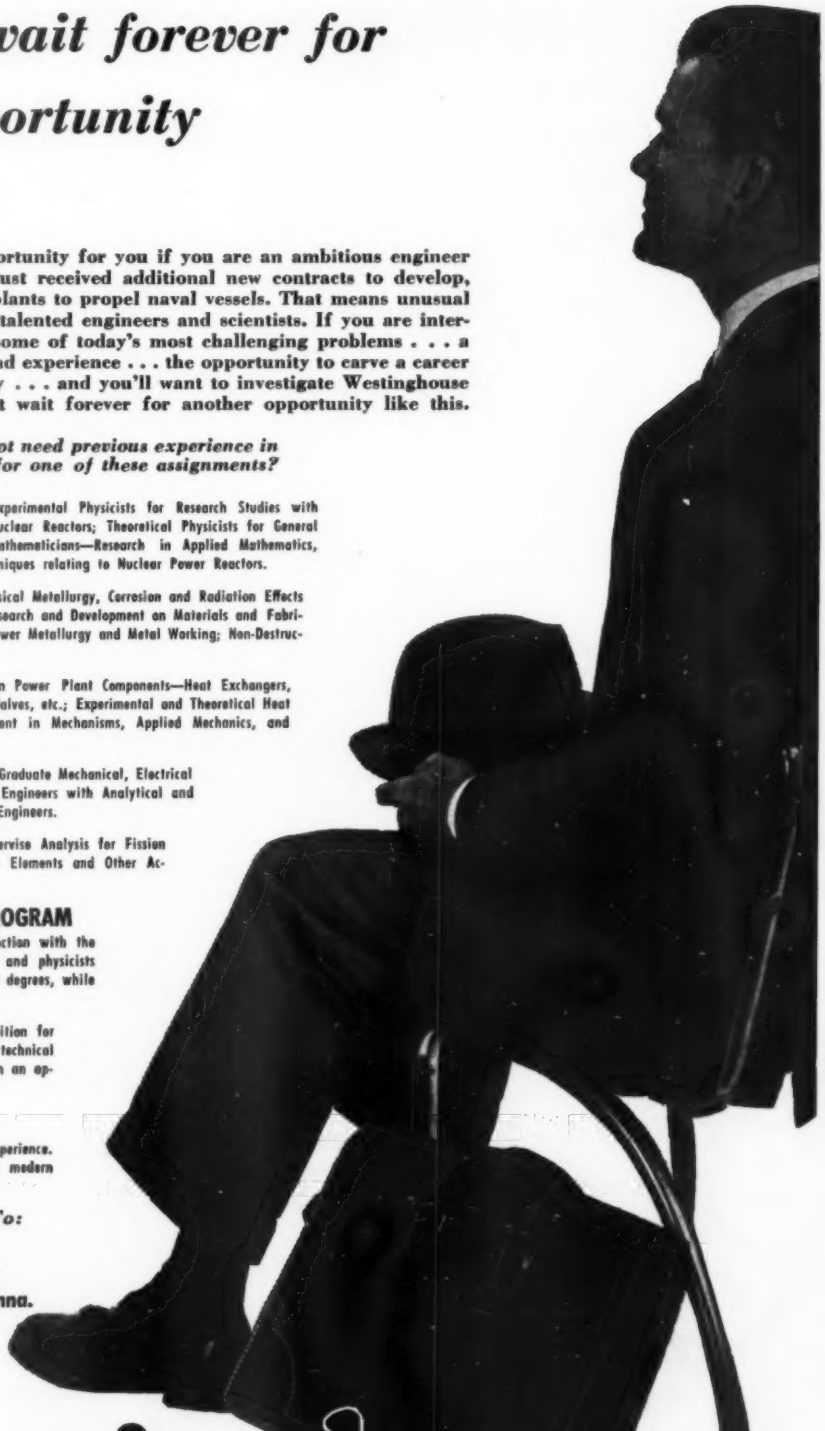

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THE TABULAR VIEW

(Concluded from page 126)

is now Roxbury. The progress of this settlement – which attracted such persons as Nathaniel Hawthorne and Charles A. Dana – is traced (page 141) by GORHAM DANA, '91. Born in Charlestown, Mass., and educated in the public schools of Boston, Mr. Dana entered the Institute to study Civil Engineering, and is secretary of the Class of 1891. For many years he was manager of a fire protection bureau. In 1928 he was coauthor with William D. Milne, '08, of a book entitled *Industrial Fire Hazards*, and in 1914 wrote *Automatic Sprinkler Protection*, which enjoyed a good sale among fire protection engineers. Mr. Dana retired in 1939.

Secondary Education. — As more and more youngsters reach the teen age and crowd existing high school facilities to the limit, secondary school education comes under increasing scrutiny. A teacher of high school science points out (page 144) her belief that the primary need in improving precollege training is the establishment of an environment, within the community, conducive to discipline and intellectual achievement of reasonably high caliber. BERTHA S. W. DODGE received the S.M. degree in Chemistry from the Institute in 1922, and has had varied experience in teaching college mathematics as well as high school science. In addition, two grown daughters have contributed to Mrs. Dodge's understanding of young people and their educational needs. In addition to "Unconscious Ambassadors" which appeared in The Review for February, 1943, Mrs. Dodge has written an elementary textbook on chemistry for use in teaching student nurses, and is author of *The Story of Nursing*, published in April, 1954, by Little, Brown and Company.

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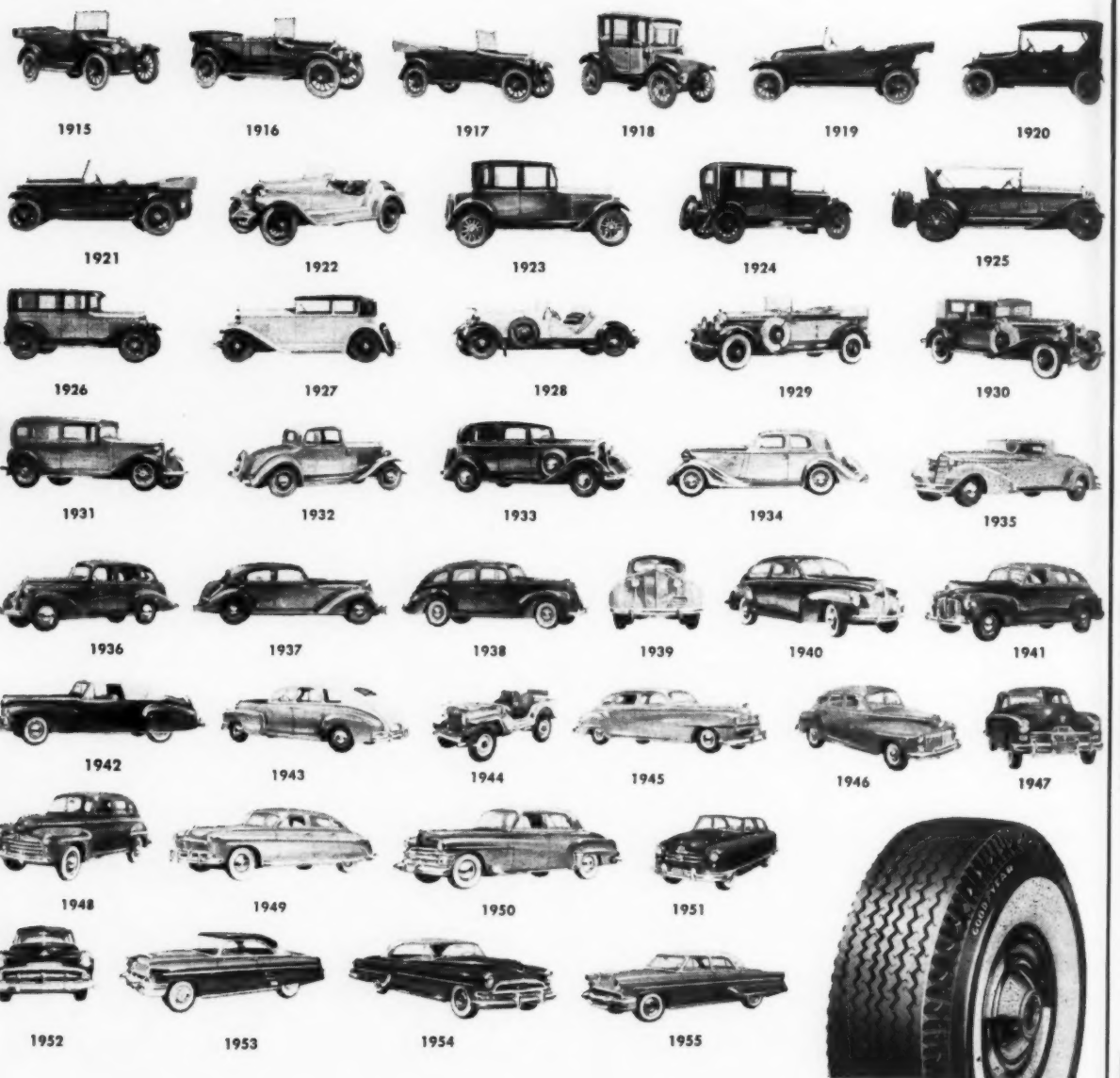

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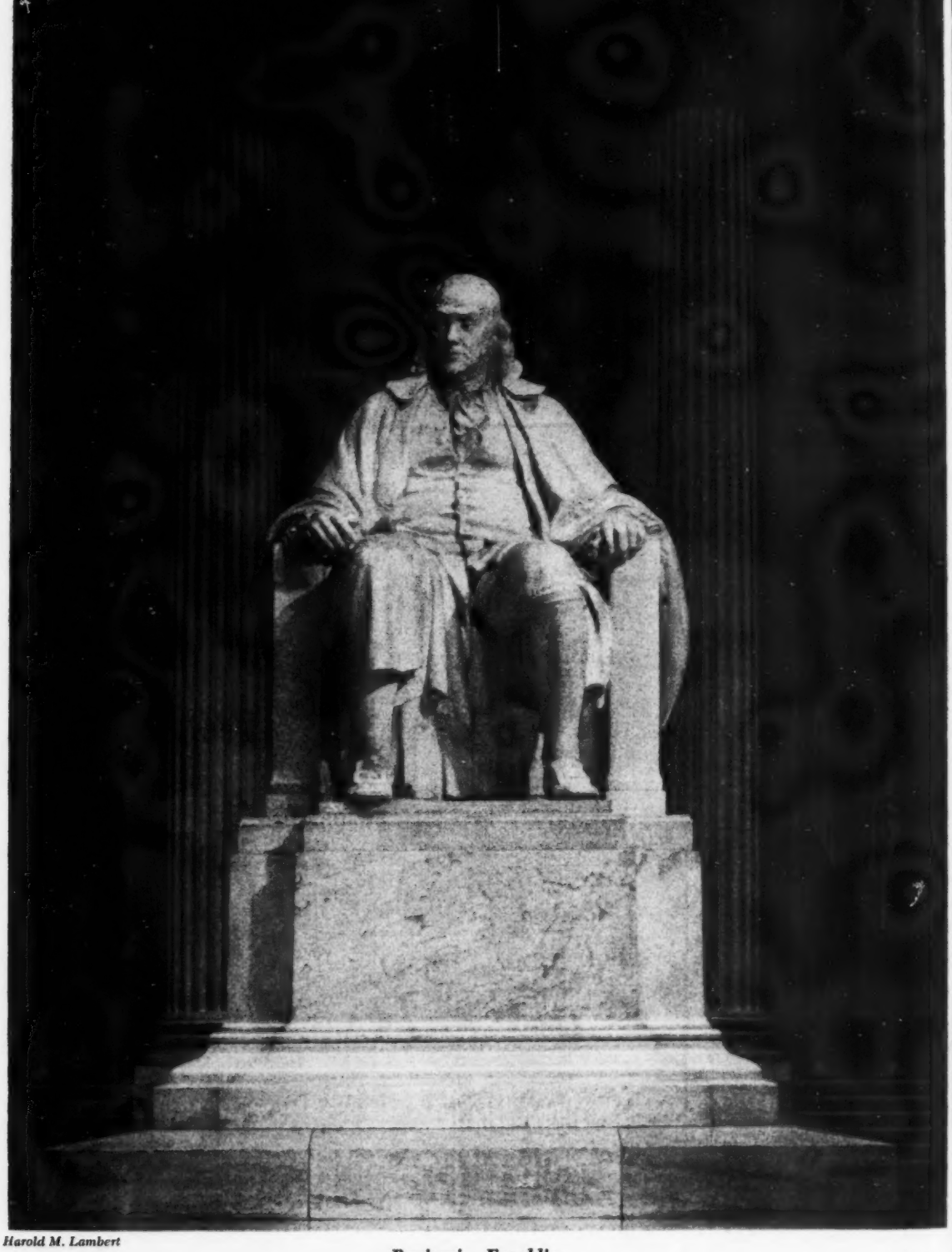


Harold M. Lambert

Benjamin Franklin

. . . rose to international eminence as writer, printer, scientific investigator, inventor, patriot, and statesman in the American Colonies. This statue, at the Franklin Institute in Philadelphia, provides a fitting frontispiece illustration in celebration of the 250th anniversary of Franklin's birth on January 6, 1706 (January 17, new style) in a two-story house on Milk Street in Boston.

THE
TECHNOLOGY REVIEW

Vol. 58, No. 3 January, 1956

The Trend of Affairs

Prometheus

> *"The rapid progress* true *science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the height to which may be carried, in a thousand years, the power of man over matter. We may perhaps learn to deprive large masses of their gravity, and give them absolute levity, for the sake of easy transport. Agriculture may diminish its labour and double its produce; all diseases may by sure means be prevented or cured, not excepting even that of old age, and our lives lengthened at pleasure even beyond the antediluvian standard. O that moral science were in a fair way of improvement, that men would cease to be wolves to one another, and that human beings would at length learn what they now improperly call humanity."*
>
> *— Benjamin Franklin to Joseph Priestley, February 8, 1780*

BENJAMIN FRANKLIN was born January 17, 1706, on Milk Street in Boston. He became the intellectual titan of our Revolutionary period, the man whom Kant labeled the new Prometheus. Under the auspices of the Franklin Institute, a year-long celebration of international scope is being planned to commemorate his birthday 250 years ago.

The list of his accomplishments defies credulity. He was the master negotiator abroad for the American Colonies. He was without a doubt the Colonies' foremost writer, and founded publications which not only gave him a comfortable fortune, but also attained immense influence. In the role of Poor Richard, he created a Farmer's Almanac that became a literary masterpiece, and which may have been read, in all its countless editions here and abroad, by more people than any other publication except the Bible. He was a noted scientist, who became a member of 25 of the leading scientific and educational societies of his day (19 of them still in existence). He invented the Franklin stove, the lightning rod, and, at the age of 82, a device (still in use) for grabbing objects on high shelves. He captioned and perhaps drew the first American cartoon.

More than any other American he forged this country's aphorisms. "Time is money," he said. "God helps them that help themselves." "He that cannot obey, cannot command." "Three may keep a secret if two of them are dead." "Early to bed and early to rise, makes a man healthy, wealthy, and wise." In all of his pungent aphorisms there was good, sound, moral and economic advice coupled with shrewd observation and keen insight to human nature.

As the creator of the most famous of all *Almanacks*, Franklin had a naturally intense interest in the weather. But with Franklin, observation was coupled with recording. Once, when waiting for an expected eclipse of the moon in Philadelphia, a northeast storm came up about two hours before the expected time of the eclipse, and, of course, obscured the event. Franklin learned later that the beginning of the eclipse had been well observed in Boston, which lies about 400 miles northeast of Philadelphia, and he commented: "This puzzled me because the storm began with us so soon as to prevent any observation and being a northeast storm, I imagined it must have begun rather sooner in places farther to the northeastward than it did at Philadelphia. I therefore mentioned it in a letter to my brother who lived at Boston; and he informed me that the storm did not begin with them till near eleven o'clock, so that they had a good observation of the eclipse. And upon comparing all the other accounts . . . I found the beginning to be always later to the northeastward. . . . " Thus began some understanding of cyclones and anti-

cyclones, although knowledge of them is still scanty.

The same constructive desire to know more of the workings of the world about him, regardless of preconceived notions, led him, from the accounts of American sea captains and from his own observations, to recognize and publicize the existence of the Gulf Stream. And he instantly applied this knowledge, by suggesting courses for the mail packets that would cut down their sailing time across the Atlantic. Since it was his custom, on his many ocean voyages, to measure the temperature of the surrounding water (often several times a day) he suggested the thermometer as an instrument for determining when a ship had entered the Gulf Stream. Although Franklin was one of the most persuasive men of his day, this was one suggestion that was not unanimously well received. The English skippers in particular wanted no part of this amateur's theories on applied science. The situation is somewhat different now. Today tankers and other ships running up and down the eastern coast of the United States regularly use Loran to position themselves accurately in the fastest part of the current when going north, and to avoid the current as much as possible on the return trip.

When Franklin retired from active business at the age of 42, it was to a period of intense political and scientific activity that lasted for another 42 years. History stresses his role as a diplomat and mediator, but it was the pursuit of science, and particularly the phenomena of electricity, that seemed closest to his heart. His book on electricity *Experiments and Observation on Electricity Made at Philadelphia,* became an important text and went through several editions. This and other writings on science made him well known in Europe and resulted in his election to membership in every important scientific society of Europe before he set foot in Paris, where he was sent after he had helped draw up the Declaration of Independence.

Whether or not he was their originator, such words and phrases as armature, charging, discharge, condense, conductor, electrical shock, electrician, negative, and nonconductor became fixed in the vocabulary of science through his usage. He demonstrated the electrical nature of lightning, and was the first to show the presence of electricity by any other way than sparks or discharges. He explained how one coating of a Leyden jar became positively charged while the other acquired a negative charge of equal amount, and verified his findings experimentally with apparatus sent him from England by Peter Collinson. In this work – coupled with his single fluid theory of electricity – he presented the law of conservation of charge. Yet he saw his first experiment with electricity in Boston when he was 40 years old, and his major contributions to electricity were made in the following half decade. His invention of the lightning rod stemmed from his independent observation that sharp points tend to draw a spark from a charged object more readily than do blunt bodies.

His celebrated kite for attracting lightning was no casual experiment, but part of a systematic study to deduce the nature of lightning. As he said in a letter, "As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and the loose filaments of the twine will stand out every way, and be attracted by an approaching finger. And when the rain has wet the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentifully from the key on the approach of your knuckle. At this key the phial may be charged; and from electric fire thus obtained, spirits may be kindled, and all the other electric experiments be performed, which are usually done by the help of a rubbed glass globe or tube, and thereby the sameness of the electric matter with that of lightning completely demonstrated."

Like Prometheus, who stole fire from the lightning of Zeus, Benjamin Franklin burned with hope for the future of man. In so far as the welfare of man could be influenced by science, his most optimistic predictions have, on the whole, turned out to be less than the actuality. But as he also foresaw correctly, the great dangers to man stem from his own uncontrolled passions, and from the barriers his suspicions and hatreds put in the way of mutual understanding. It is appropriate therefore, that a central theme of the 250th Anniversary Celebration of his birth is a worldwide program of voluntary exchange of ideas between nations.

The Unregenerate

THE ability to regenerate parts amputated or broken off is stronger in plants than in animals. Regenerative ability of one plant is a source of summertime vexation to suburbanites, who carefully amputate their lawns with mowers only to find the grass lustily regenerating before a week has passed. Woody perennial plants also regenerate vigorously; a horticultural example are hedges, which continue to grow no matter how ruthlessly they are cut back. Even the stumps of huge old trees often put forth vigorous young shoots after the trees have been felled.

In the animal kingdom regeneration occurs in hydra (aquatic polyps), planarians (flatworms), earthworms, amphibians, crustaceans, and starfish; and to a limited degree in mammals including man.

Animal regeneration was first reported scientifically in 1744, on the basis of observation of hydra. In these animals the phenomenon is most pronounced; if a single organism is cut into numerous parts, each part will regenerate an entire animal. In flatworms and earthworms a severed head, tail, or mid-section will replace all missing parts. Starfish regenerate a complete animal from just one of the five arms with a bit of the central disk. This fact unfortunately was originally unknown to oyster growers, who seek to destroy starfish because they regularly prey upon oysters. At one time the oystermen dredged up starfish, chopped them in pieces and threw them back into the sea with the belief that they had been killed. This practice instead increased the starfish population much faster than normally would have occurred. Relatives of the starfish, the brittle stars, combine regeneration with an ability called *autotomy* (self-amputation) as a

means of defense. If one of the animal's arms is seized by an enemy, the brittle star instantly casts off this member, and later speedily regenerates it.

Crustaceans (such as crayfish) and amphibians (such as salamanders) – animals considerably higher on the developmental scale than any mentioned so far – are able to regenerate severed limbs or tails. Some crustacean species employ autotomy, detaching appendages as necessary to escape from predators.

As we look still higher up on the developmental ladder, we find that the mammals including man can regenerate certain tissues, such as skin, hair, nails, liver, bone, nerve, and muscles. In the human being, the hair has more vigorous regenerative powers than any other tissue. This is a bane to men, as in the present clean-shaven era it necessitates matutinal sessions with razor or electric shaver, and fortnightly expeditions to the barber chair. For women, contrariwise, regeneration of hair is a boon, as it provides an ever-replenished supply of material to be sculpted and molded by beauticians into the latest of the highly mutable feminine hair fashions.

Like hair, the nails of mammals are constantly replenished. In wild animals, the nails as constantly wear away as the beasts walk on all fours, and as they use nails for tools and weapons. Animals in zoos and dogs in the home, which are relatively inactive and need not fight or dig for their food, must often have their nails trimmed lest they grow to ungainly lengths. Horses tread on the nail of the middle toe of each foot. In wild horses, regrowth of this nail – the hoof – keeps neatly apace of the wearing away of the surface that touches the ground. When horses are shod, such natural attrition is prevented. Hence, the blacksmith must pare and file the hoof at each shoeing. The human being's hands and feet are usually well shielded from wear and tear; hence man must regularly trim his fingernails and toenails, or else delegate this operation to manicurists, pedicurists, or chiropodists.

Regeneration of skin may be observed whenever a cut heals; regeneration of bone is evidenced when a fracture mends.

The front or incisor teeth of rodents continuously regenerate from the roots, for these teeth are rapidly worn away at the cutting edge, in consequence of the animals' gnawing habits.

In general, however, entire organs of mammals cannot be regrown, because tissue regeneration is not sufficiently co-ordinated. One exception to this rule is the blood vessels. The man in the street is now scientifically erudite concerning the cardiovascular system, as a result of the flood of articles on the subject appearing in the lay press after President Eisenhower's heart attack in the autumn of 1955; therefore, who does not now know when a major blood vessel is interrupted by blockage or by being cut, "collateral circulation" may be established by new vessels growing around the defect. This is tantamount to regeneration of a whole organ.

Sometimes regeneration in lower animals gives rise to strange aberrations. Thus occasionally when an earthworm loses its head, it regenerates a second tail in place of the missing member. Such a monster would be perfectly viable, were it not that without a head it lacks eating apparatus and therefore starves to death. If the eye is cut out of certain marine crustaceans, they may grow antenna-like sensory organs in place of the eye.

In the human being, aberrations of regeneration may occur in healing of the skin and underlying tissues, as when the lesions of smallpox, acne, or boils heal to leave unsightly pits, or when a cut leaves a bad scar. Recently dermatologists have come to employ regenerative powers of the skin to rectify such cosmetic defects, and also to eliminate naturally occurring pigmented blemishes and unwanted tattoos.

The procedure employed is merely a skillful grinding away of the skin at, and immediately around, the defect. This grinding is done with circular stones, burs, or wire brushes spun at high speed by means of a motor-driven flexible shaft, similar to those employed by dentists and also found in many modern home workshops. The area to be ground is made insusceptible to pain and also made sufficiently rigid for easy grinding by "refrigeration anesthesia," which means local freezing accomplished by spraying with a highly volatile substance such as ethyl chloride. After the desired amount of tissue has been ground away, the area is carefully dressed and otherwise protected against infection. As a rule relatively blemishless skin regenerates within a few weeks. When scars are deeply pitted, the procedure may need to be repeated as many as three times; this may be freely done at half yearly intervals.

One might well wish that the human being possessed full powers of regeneration, and were able to replace any part lost through injury or removed surgically. But it is heartening to know that skin regeneration is useful in the remedying of cosmetic defects, which in this competitive modern world may transcend considerations of vanity and indeed be grave economic handicaps.

New Magnetic Materials

UNTIL recent years, all commercial magnetic materials have been metals which are characterized by low electrical resistivity. Because of their low electrical resistivity, undesirable losses arise in metals as a result of induced eddy currents. Such losses can be reduced by rolling magnetic metals into thin tapes or sheets; thicknesses as small as 0.000125 inch are used in modern, high-frequency applications. However, the required techniques are expensive and do not produce sufficiently uniform results for large information-storage units in modern, high-speed computers. Further, they are too slow when used in coincident-current circuits even when eddy-current effects are essentially eliminated. Eddy-current losses will also be reduced if the electrical resistivity of the magnetic material can be increased, and this possibility has led to the development of a new class of important magnetic materials.

Development programs, both here and abroad, have been directed toward the production of nonmetallic magnetic materials of high electrical resistivity. These materials are polycrystalline, sintered metallic oxides, called ferrites, which are the chemical and structural analogues of magnetite, the

magnetic oxide of iron, Fe_3O_4. The electrical resistivity of ferrites is from 10^8 to 10^{12} times that of metals showing substantially the same magnetic properties; eddy-current losses are, therefore, greatly reduced. Moreover, a considerable variation in magnetic properties is possible in ferrites through different cation substitutions in the magnetic formula.

The new magnetic materials have already proven themselves in many applications, particularly at high frequencies or where high speeds are required. One of the most striking of these applications has been the use of ferrite cores as information-storage elements in high-speed digital computers.

In the last few years, development work on ferrite materials has gone on steadily with gratifying results. For example, improved materials used with improved memory techniques promise a thirtyfold increase in memory performance rating over the first magnetic core memory installed 20 months ago, a memory which was, in turn, fourfold superior to the electrostatic memory it replaced. The performance rating evaluates storage capacity, reliability and speed; it is expressed in bits of information stored per cathode-microsecond. The new magnetic materials are the result of a program of research aimed at both theoretical and practical problems.

In addition to high electrical resistivity, the magnetic material for high-speed, coincident-current, random-access memories must also have a rectangular *B–H* loop with flat top and steep sides. The coercivity (that is, the reverse magnetic field which has to be applied to annul the residual magnetism of the substance) should be low to keep power requirements at a minimum. Finally, the material should be adaptable to manufacture in large quantities with uniform magnetic and electrical properties.

The first phase of a program to obtain such cores consisted of an evaluation and selection of the best commercially available ferrites. In order to provide a basis for new material development, a scientific understanding of the magnetic properties of existing ferrites was needed. This understanding would permit an improvement of existing materials and suggest new materials with inherently better qualities. Accordingly, a program was established under the supervision of John B. Goodenough, physicist, and Francis E. Vinal, '41, chemist, staff members of the Lincoln Laboratory, to study ferrites for computer applications.

The first step in this program was to determine the physical mechanisms controlling the flux-reversal time and the shape of the *B–H* curve, and to express these factors in terms of fundamental, measurable parameters of the magnetic material. Once this was accomplished, it became necessary to study the crystalline forces, with their chemical and processing dependencies, which are responsible for the magnitude and sign of the fundamental, measurable parameters. Simultaneously with the theoretical and associated experimental work, a program was initiated to isolate and study the many processing variables in the production of existing polycrystalline, sintered ferrites.

A theory of flux-reversal in polycrystalline materials has been proposed, together with a theory of the factors which influence the shape of the *B-H* loop. These studies indicate that short flux-reversal times and square *B-H* loops can be achieved simultaneously only by compromising the most desirable values of coercivity and intensity of magnetization; the coercivity limits the flux-reversal time in a coincident-current application, and unless grain-to-grain alignment can be introduced, the intensity of magnetization limits the squareness of the *B-H* loop. The theory also predicts that square-looped materials cannot be obtained if lamellar or grain-boundary precipitates are present, whereas small inter-granular flaws can be tolerated. An extensive survey of the magnesium-manganese ferrite system has shown that the compositional region in which square *B-H* loops are found is bounded by regions in which lamellar or grain-boundary precipitates occur; the loop shape is relatively insensitive to the density of small granular voids which are usually present in these sintered oxides. The theory also predicts that the predominant contribution to the coercivity in a single-phase, polycrystalline material is inversely proportional to grain size. It has been found possible to control the magnitude of the coercivity, within limits, by controlling grain size. Therefore, for a material with a fixed figure of merit, it is now possible to control the flux-reversal time by controlling the firing cycle.

To determine the crystalline forces which are responsible for the magnitude and sign of the fundamental, measurable parameters, present work is going on in two directions. Investigations are under way which are designed to show how the chemical bonding and the processing variables determine the chemistry of a given sintered oxide. Previous investigators have assumed that the chemical bond in the ferrites is predominantly ionic, but a study of the influence of covalent bonding in these materials is proving extremely fruitful. A systematic analysis has been conducted for each of the many processing variables, including chemical composition, mixing, forming, heat treatments, atmospheres, density, and micro-structure. Substantial progress has resulted from this investigation.

The progress which has been achieved in this program becomes evident when the properties of currently available memory cores are compared with those of the best commercially available cores of two years ago. Loop rectangularity has been improved while the operating margin (as measured by maximum permissible variation in driving current) has been widened by as much as 100 per cent. Reduction in noise signals and improved discrimination in output signals has been achieved. Also, an increase of about 33 per cent in operating speed has been realized and measured by pulse response characteristics. Finally, at least 95 per cent of the cores produced are sufficiently uniform as to be acceptable for the intended use.

As a consequence of improved magnetic materials, computer design may now be undertaken in terms of larger, more reliable random-access memories with greatly improved performance ratings and higher speeds. In addition, the research work undertaken to improve ferrite materials for computer service will undoubtedly yield additional benefits.

The Place of the Small Liberal Arts College

The True Test of an Institution Is Not Its Buildings, Its Faculty, or Its Endowment, but Rather in the Graduates It Gives to the World

By JAMES S. COLES

One might ask, "What are the common grounds between a small liberal arts college like Bowdoin and M.I.T.?" Bowdoin has less than 800 students compared with the Institute's 5,000-odd. In fact, the Bowdoin students number fewer than the M.I.T. Faculty. Bowdoin is for men only, while M.I.T. is coeducational. The position of M.I.T. is pre-eminent in the nation's scientific and economic community and in its contributions to the national defense. Such pre-eminence as Bowdoin may have is primarily limited to the small group of her enthusiastic and loyal alumni, and to those who may have had some connection with her. Sometimes, even some of these alumni are not so loyal or enthusiastic, which points up another difference: Bowdoin regularly plays intercollegiate football, although there are those who occasionally doubt that she has a team.

Because of my own early interest in science, and my training and work in physical chemistry – which occupied me fully until the summer of 1951, a little more than four years ago – I sometimes wonder at my present position and interest in one of the liberal arts colleges.

There is a story about a discussion between two members of the Harvard faculty soon after Conant was named the president of Harvard. One of them said, "He may be a fine chemist, but he'll never make a good President." The other pointed out that Charles William Eliot had been a fine Harvard president, although prior to that he had been a chemist – indeed, a professor of chemistry at M.I.T. To this the first replied, "Yes, but Eliot was a mighty poor chemist." I don't know what may have led Professor Eliot to forsake chemistry to become a college president, but I fear my friends in the Chemistry Department here might perceive some similarities which I won't pursue any further.

That there has been in the past a dichotomy between the liberal arts and technology is unquestioned. In my own youthful arrogance I was apt to think of liberal arts students as merely "executing intellectual minuets." I joined with many other aspirants toward science and engineering in considering a liberal arts college as the perpetual Saturnalia of modern civilization; its students the "lotus eaters" of the new generation. A fine college, as opposed to a poor one, was one where the freshmen could not be diverted from their intellectual pursuits in spite of the best efforts of the sophomores. It was said that one of the greatest values in being a graduate of a liberal arts college was that forever after you would never have to buy bonds from a stranger. The existence of these colleges was justified in my mind because I felt that no college could ever hurt anyone who was willing to learn something after he was graduated. You can appreciate that with these impressions the M.I.T. program of the early 1930's had much appeal for me.

On the other hand, this same arrogance among those who felt the new power of science and technology led to reactions such as those of Anthony Standen in his book *Science Is a Sacred Cow** which can best be criticized by saying it was 20 years out of date when it was published. Without question, the inability of scientists to communicate the exciting importance of their frontier discoveries of the 1920's to an awaiting public, justified the charge of obscurantism placed on them by men like Whitehead. We must admit, too, that many technical men of years past have had a blindness equaled today only by some Congressional investigating committees. The exponents of the liberal arts quite properly held that equally important to an engineering student to learning how to earn a living, was for him to learn what to do with the living after he had earned it.

Much of this feeling still holds among certain faculty segments. In a recent national survey some scientists at large institutions maintained the quality of work in liberal arts colleges to be poor, especially in the sciences, and further, that it was unfair to young people to offer them the meager diet found in such schools. On the other hand, men teaching in small liberal arts colleges are tempted to believe that the activity in the liberal arts at a place like M.I.T. is of a sort suggested by the title of the recent book *Machine Translation of Languages*,† edited by Professor William N. Locke, Head of the Department of Modern Languages (incidentally, a graduate of Bowdoin College).

These differences, which do exist among groups both primarily interested in higher education, are reminiscent of the discussion of two British clergymen

* New York: E. P. Dutton and Company, Inc., 1950.

† New York: John Wiley and Sons, Inc. (with the Technology Press), 1955.

Dave Lawlor

With an enrollment of about 1,000 students, Colby College in Waterville, Maine, is representative of the liberal arts colleges whose role in modern education is discussed by Dr. Coles.

of opposite persuasion, who found themselves sharing a compartment on an English train for longer than they wanted to be together. It is easy to imagine the testiness and the polite deference of their forced conversation, culminating in the remark of the one clergyman to the other at the end of their journey, "It has been interesting to have heard your views, Reverend Sir, and I wish you Godspeed as we part, each of us to go about the Lord's work, you in your way, and I in His."

The technical institutes of this country were founded to fulfill a need which was not being met by the liberal arts colleges of the Nineteenth Century. These infant schools properly did not emulate the existing colleges, for no institution can be great by imitation. That the technical institutes fulfilled the need for which they were founded is attested by the economic and productive position of the United States, and by the common conveniences of everyday American life.

In fact, the successes of science and technology have been almost overwhelming, and have far outstripped the advances in our knowledge and understanding of human relations – economics, sociology, political science, and government – and our ability in the recording and classification of human relations through the study of history.

In recent decades, however, industrial and economic leaders, as well as leaders in technical education, have recognized that man cannot live on bread alone, nor can he live on iron or steel, titanium or vanadium; nor can he live solely on poetry, art, or music. They recognize that there is a void in a nation whose people don't worry as much about philosophy or literature as they do about where to park their cars. They recognize that while the attainments of science cannot wait for the systematizing of our understanding of social forces, neither can science continue its advance oblivious to these forces.

For this reason men everywhere have applauded the introduction by leading technical institutes of liberal arts courses in their program, and the establishment of departments in the humanities and social studies on an equal basis with the sciences. They rejoice that the strength of these institutes presently supports all areas of human culture, and they acclaim the success of these programs, as exemplified here at M.I.T. They recognize that the faculties of some technical schools are more progressive in their attack upon the problems and teaching of the humanities and social sciences than are some faculties in the liberal arts colleges themselves.

All of you can easily agree with me that we have no fear about the future of science and technology – its progress is assured. Problems in these areas are in competent hands. But we do have much trepidation about future relations between men, governments, and societies, and their adjustment to the intellectual and material products of science. The greatest problems, not only of world peace, but of human preservation, are not those of science, but rather those of sociology, politics, economics, and government.

The problems of science and technology are relatively easy. They are capable of precise definition, of quantitative expression; they will yield to the power of controlled experiment, and theoretical or mathematical consideration.

Contrariwise, our social, economic, and political problems – and indeed our problems of philosophy – are much more diffuse and nebulous, difficult of definition, evasive of exposition, not subject to easily controlled experiment, nor to verifiable, theoretical

interpretation. In spite of introductory efforts in this direction, the powerful quantitative techniques of mathematics – to which modern chemistry, physics, and engineering are so indebted – have yet to be applied in any large degree to other areas. Unquestionably the new computers will revolutionize research in the social sciences to an even greater extent than they will in the sciences, which have already benefited from strong mathematical tools. Witness, for example, the work in machine translation in which Professor Locke is interested.

There is another difficult aspect in achieving a solution for these most important problems in human relations, and I mention this at the risk of censure by exponents of the liberal arts, on the Bowdoin faculty and elsewhere. It is my belief that on the average, across the country as a whole, students with the abler minds are more often attracted toward the sciences and engineering than toward other fields. I do not say that the sciences do not need them, for heaven knows they do, particularly at this juncture of our history. I recognize also that many brilliant men are interested in the humanities and social sciences. This greater and selective attraction of the sciences is a natural consequence when a conscientious and sincere boy, with a brilliant but yet immature mind, begins searching for the problems of the world to be solved to which he hopes to apply himself. He finds first those problems which are easily defined and most clearly described – those in mathematics, the sciences, and engineering. (For those youngsters whose approach is less idealistic, and based upon professional opportunity, the same result will obtain, for through the nature of our social system, economic support will be stronger where problems are clear in definition, and subject to organized attack.)

This same lad is prepared for scientific study, for he has had the capability to excel in his early work in mathematics, so basic to all the sciences. By the time the man with the fine mind – "The Man with the Grey Unflanneled Noggin" – has sufficient experience and knowledge to recognize the importance of the less well-defined problems in the nonscience disciplines, he is already so far committed in science that he cannot change his field without great sacrifices. Thus, on the average, the competency of the attack on these greater problems of humanity is not so great as it could or should be were there to be an earlier recognition and appreciation of these problems by more of our ablest youth.

The position of the liberal arts, embracing all of science, social studies, and the humanities, is thus well recognized. With the behemoths such as Harvard and M.I.T. so strongly supporting the liberal arts, where then is there a place for the small liberal arts college? It can and does present a strong integrated program in the humanities, social studies, and sciences, but that program is no stronger than similar ones in larger institutions.

As in all matters, there is involved in this distinction the recognition of individual differences. The justification for the small college as opposed to the large depends in large extent upon the particular requirements of the student who selects it. The small liberal arts college, with a predominantly undergraduate student body, places primary emphasis upon the instructional program. In so doing, it seeks for its faculty the most competent scholars – the same sort

Dave Lawler

Along with Bowdoin College, of which James S. Coles is president, Amherst College at Amherst, Mass. (shown above) is one of a score of colleges which co-operate with M.I.T. to provide training in the liberal arts as well as in engineering and science. Upon the successful completion of a five-year program, the student is awarded suitable bachelor degrees from each of the educational institutions in the combined plan.

you seek at M.I.T. – but it further stresses a high degree of teaching ability and marked interest in undergraduates.

The emphases upon instruction in a small college are manifold. There is a budgetary emphasis, made possible because there are not the extensive demands on the resources of the college for the support of an intensive research program, such as at a larger university or technical institute. The college's resources are primarily for the support of the undergraduate instructional program.

There is also the philosophical emphasis upon "teaching" in a small undergraduate college. The faculty are selected because of their interest in teaching. They realize that their success at the college will depend principally upon their successes in the classroom and with their students. Contrary to the opinions often held elsewhere, they realize, too, that to retain their value as teachers, they must maintain a lively interest in their chosen field. Hence, the college encourages, and the faculty actively follow, scholarly pursuits outside the classroom.

In the modern liberal arts college, facilities for research and scholarship are not lacking. Bowdoin has excellent laboratories for physics, biology, chemistry, and psychology, as well as for music and drama. The library has almost a quarter of a million volumes, and there is ready access to the libraries of the world, by loan or by microfilm. That a man can be a creative scholar in a liberal arts college environment is demonstrated by the productivity of the Bowdoin faculty, averaging 20 to 25 articles published each year, in addition to numerous addresses and learned papers presented before distinguished groups. While I do not have exact figures, in the past five years approximately 10 texts written by members of the faculty have been published by reputable firms. (This does not include the publication by a single professor within the last decade of 10 books of fiction, semifiction, and poetry, more than 30 magazine articles, and over 200 poems.)

As exemplary of the recognition which can accrue to a faculty in such an evironment, a man who retired two years ago has been since deluged with invitations from one or another of several universities to join its faculty as a visiting professor. This man finally succumbed, and is presently conducting a graduate seminar in medieval history at a large state university. Another man has been frequently a visiting professor at universities at home and abroad, and next year will occupy a visiting chair at the other Cambridge, in England. These distinctions all come to a small and intimate faculty.

The identical men carry the regular undergraduate teaching load; the totality of their efforts in instruction is directed toward the undergraduate, to his tremendous advantage. For example, I can claim (with justified pride) that the quality of instruction throughout the program in freshman English at Bowdoin this very year is unsurpassed.

The smallness of the faculty in itself gives a coherence and integrity impossible at larger institutions. There is a faculty group responsibility, stronger by far than the lines separating departments. The faculty includes among its members the newest instructor as well as the distinguished graybeard. The small college faculty has dignity, but avoids the ponderousness of the "academic senate," and the brash young instructor with fresh ideas helps materially in keeping the sage elder statesman alert to progressive thinking unimpeded by experience; the statesman faces the necessity of making his own long-held beliefs come alive. Then, too, with a small faculty there is the greater flexibility that is impossible in a large group – a flexibility built from intimacy and confidence, which is felt with respect to curriculum, standards, and many other aspects of the college's work.

Among the students themselves, the small college provides greater intimacy between different campus groups than is possible at a larger institution. It is very hard to define the size of a small college, and study will show that all those which have maintained their quality have expanded in size over the years at a fairly constant rate. This is true of Bowdoin, where with the exception of the war years, the slope of the growth curve for the first decade of this century predicts all subsequent enrollments within plus or minus 10 per cent. (President Baxter of Williams once defined a small college as one where each student can expect to know every other student he meets on the campus, and if a student meets a man he doesn't know, he feels a responsibility to find out who he is.) It's something like the definition of a small town – a place where everybody knows whose check is good. A small college is one where everybody knows who is next to be elected to Phi Beta Kappa, and who is next to flunk out and why.

This enforced intimacy actually gives a student a wider experience in human relations than he would otherwise have, for he cannot limit his acquaintance only to men of similar views and beliefs to his own, but perforce will have friends among men of widely varying interests. In many ways, the small college has advantages similar to some of those claimed for the Institute for Advanced Study at Princeton: the intimacy of a small group, the advantages of close association, and the restricted use of relatively limited resources to those persons and projects able to profit most.

The common experience of the whole community enjoying the same concerts, the same lectures, the same joys and the same griefs – all these develop an integrated sympathy and understanding. The cup of coffee with one's professor or one's student in the Union; the chance encounter on campus of the man whose lecture the hour before may have had a difficult point – all these are part of the normal life of the small college. The atmosphere seems leisurely compared with that of the larger institution, but through that relaxation itself, life is more contemplative, ideas are more thoughtfully received and considered, and the student or professor, as an individual, perhaps held in higher esteem.

The small liberal arts college and the large technical institute have many differences, but also many things in common. In their differences, each makes its unique contribution; there is no strength in imitation. An institution of higher education is healthy and vigorous only so long as there may be a contrast between its past and its future. The adventure of the

(Concluded on page 170)

Raymond E. Hudson

A view of Brook Farm as it appears today. Except for the wooden sign, there is little to mark these buildings as the center of an unsuccessful experiment in socialized living more than a century ago.

Brook Farm . . . . . By GORHAM DANA

In these days of wars and rumors of wars, of political strife, of dishonesty in high places, of greed, theft and murder, of droughts and floods, of fires and of gales, of air and sea disasters, it is well to turn back the pages of history to a time when there was less trouble in the world and more idealism, good will, and co-operation, less worry and more happiness in life. So let us take a glimpse of the conditions in the 1840's.

If you drive from the Institute toward Dedham on the Veterans of Foreign Wars Parkway, you will come to Baker Street in West Roxbury about a mile beyond Hancock Village. If you then turn right, toward Newton, in about half a mile you will come to a group of wooden buildings on the left of the road. A sign, reading "Site of Brook Farm," marks the famous socialistic settlement which was occupied for a few years, beginning in 1840, by a group of outstanding philosophers, writers, liberal ministers, teachers and students – all seeking a new type of society which would give more happiness and security to the human race. It was one of the first of a number of socialistic experimental settlements in America which suddenly sprang up during the Nineteenth Century, but it was not very large nor did it last very long. It was particularly noted, however, for the high type of thinkers and writers that it attracted; for a century ago, the very elite of society participated in the Brook Farm experiment. In their recent *Pocket History of the United States,* Nevins and Commager state that Brook Farm was "perhaps the nearest thing to a socialistic order that had been known in America since the Mormon Commonwealth in Utah."* The origin of Brook Farm may be traced, in part, to the writings of the socialistic dreamers such as Robert Owen of England (1771-1858) and Charles Fourier of France (1772-1837), in part to the Transcendental Club of Boston, and to the business depression in the United States which started about 1837.

In attempting to comprehend the full significance of the Brook Farm settlement, it will be helpful to recall that the industrial revolution, which had its first repercussions in England, created a new way of life which naturally produced some growing pains as it evolved. With the growth of industrialism, individuals tended to leave their private business pursuits—which were primarily agricultural in character—and became involved in comparatively large-scale operations in which they lost control of the tools of production. Reaction against this new mode of in-

* Allan Nevins and Henry S. Commager, *Pocket History of the United States* (New York: Pocket Books, Inc., 1945).

dustrial life brought forth the first of the modern concepts of socialism. The community or socialistic philosophy of such early leaders as Robert Owen of England, and François Marie Charles Fourier of France, stimulated the establishment of socialized communities in the United States about a century ago. In a few instances, religious beliefs formed an important element in the formation of such socialized communities but in most cases religious beliefs were a minor side issue. Almost universally, the desire to improve man's economic and social status was a major goal of such experimental communities as Brook Farm represented. Almost universally too, it was hoped that the utopian way of life might be achieved through some form of community living in which the individual ownership of property, as well as benefits from the fruits of individual labor, was expected to play, at most, a minor role. In their efforts toward submerging—or at least minimizing—individual initiative and personal reward, the social community experiments which occurred in the United States a little over a century ago ran counter to the theme of rugged individualism that reached its peak in America.

History has a habit of repeating itself. To be sure, variations and elaborations occur so that no two sets of conditions are identical. But history deals with human beings whose fundamental aims, hopes, and aspirations do not change greatly from one continent to another, or from one century to another. Hence, in the light of today's turmoil, it will be interesting and instructive to examine some of the earliest experiments in socialized community living, and to review their successes.

Owenism

Robert Owen, born in Newtown, Montgomeryshire, Wales, in 1771, was a natural born reformer whose socialistic experiments in England, and later in the United States, attracted considerable attention. Influenced by the poor working conditions which he found in English cotton mills, he set out to improve the lot of the working classes by education and by instilling the virtues of order, cleanliness, and thrift. At first his efforts were limited to reforms in a factory of which he became manager at the age of 19. As his sphere of activity increased and as he enlarged his philosophy of reform, Owen came to develop some of the earliest tenets of what is now called socialism. He did not make his appeal on the basis of social classes, although only the working classes accepted the leadership he offered.

Since Owen had lost faith in the prevailing forms of religions, it is not surprising that the social philosophy he developed contained elements of moral admonition. Owen believed that man's character is not made by himself, but rather that it is the result of environmental circumstances which are, for the most part, beyond his control. He believed firmly that proper education provided the best means of developing character and of eliminating the want and misery which was often associated with Nineteenth Century working classes. Owen developed the idea that, from early childhood on, human beings should be placed under influences that would develop their moral, physical, mental, and social attributes. He concluded that character could be developed by government, and that crime and misery could be removed by government effort if all united for this purpose.

Armed with such a philosophy and the zealousness of a reformer, Owen recommended the establishment of communities of about 1,200 persons who would live in one large building with public kitchens and mess halls, but would have private living quarters. The communities were to be self-contained, and therefore every essential service should be supplied by a wide variety of employment. The best machinery was to be made available for labor whose activities would center about agriculture. Work, and the benefits of individual toil, were to be shared in common by all in the community; each person was to be fed by all and, in turn, was expected to work for all. Children over four years of age were to be brought up by the community. Many of Owen's ideas have a familiar ring today.

Another view of the buildings at Brook Farm at the present time. The road shown here is much the same as when it was trod by idealistic planners of a new social order in the mid-Nineteenth Century.

Raymond E. Hanson

Fourierism

After achieving considerable success initiating educational reforms in factory towns in England, Owen came to the United States to test his socialistic ideas on a larger scale, untrammeled by the restrictions of traditional thinking which he encountered in England. In Indiana, Owen purchased a 30,000-acre tract of land on the Wabash River from Father George Rapp, a religious leader who had set up his own community of German emigrants. Here Owen established a socialistic community which he called New Harmony. After about three years of operation, the community failed and was abandoned. Owen established 10 other settlements in America, including four in Indiana, three in New York, two in Ohio, and one each in Pennsylvania and Tennessee, the total population of which was 1,400. All of Owen's socialistic settlements failed, but their establishment was of importance in leading to the experiment at Brook Farm.

Another early advocate of socialism who influenced thinking of the Brook Farm group was François Marie Charles Fourier, born in Besançon, France, in 1772. Fourier became deeply impressed with the idea that individualism and competition were necessarily imperfect and immoral and ought to be supplanted by co-operation and united effort. His ideas were worked out at great length in a pamphlet which was published anonymously in 1808. In this publication he set forth the idea that the free development of human nature, or the unrestrained indulgence of human passion is the way to happiness and virtue. He believed that society should be reconstructed to do away with unnatural restrictions, and held that a co-operative or united industry and communal living would yield the desired goal.

Fourier advocated the division of society into communities or phalanxes, each containing about 6,000 persons. Each family could have its own private living quarters, but all were to be housed in the phalanx buildings, and rich and poor were to be intermingled locally. Members of the phalanx were to have a certain amount of soil allotted to them for cultivation. Members of the phalanx were to work for the benefit of all in the community; they could change their employment at pleasure and menial tasks would be rendered attractive by adopting proper attitudes. Part of the profits of the phalanx were to be used to furnish each member with the minimum sustenance, and the rest was to be distributed in shares to labor, talent, and capital. Thus, private property was not necessarily to be abolished. Fourier believed in labor-saving machinery, communal kitchens and shops. He believed that the state should organize vast depots for staple products, such as cotton and wool, and that the state or community should take over the functions of middle man as intermediary between producer and consumer.

In his earlier writings, Fourier held that the institution of marriage should be abolished (because it imposes unnatural bonds on human passion) and a system of license was to be substituted for marriage. He felt that other features of family life should be preserved, however. These ideas were dropped in later writings. Fourier's writings were lengthy and his reasoning somewhat obscure, and, by many, were considered to be fantastic nonsense.

Fourier made an unsuccessful attempt to establish a socialistic community in France. The Fourier group was more successful than that of the Owenites in establishing phalanxes in the United States. In all, at least 36 such phalanxes were set up in 34 states, including three in Massachusetts. The larger communities had more than 400 members, and at one time the entire membership of Fourier settlements totaled more than 8,000 persons. But the average life of the Fourier communities was about two years and the longest lasted but six years.

The Depression

Following the War of 1812 there was a good deal of interest in America in the idea of socialistic living. The serious financial depression beginning about 1837 caused great distress, and enhanced thinking

Raymond E. Hanson

Meadows and woods, similar to the contemporary view shown here, were familiar sights to members of the Brook Farm community about a century ago.

along socialistic lines, for many persons had lost their jobs and bank closures were common. Prices increased to such an extent as to cause great worry over the high cost of living. Meetings were held to discuss economic situations, and much thought was given to means which were believed to be effective in reducing living costs. The theories of Owen and Fourier were filtering into the United States, and communal living was being discussed as a palliative for the economic conditions of the times. Might it be possible that the socialistic theory could be a solution to the depression? Is socialism worth trying? These were the questions in the minds of many persons in this trying time. As was destined to happen a century later, many persons were willing to grasp at any means, however unsound, which appeared to provide economic security.

Thus it happened that many settlements other than those of Owen and Fourier, suddenly sprang into being along more or less socialistic lines. At one time, more than 200,000 persons flocked to these settlements which, in a short time, passed away. Except possibly as outgrowths of quite a different kind than were planned by Owen and Fourier, none of the experimental communities is in existence today. None of them produced any substantial influence on the Brook Farm group, which is the only one of these experimental colonies with which we shall be concerned.

Brook Farm

A Boston minister and pastor of the Purchase Street Unitarian Church, the Reverend George Ripley, was the prime mover in organizing Brook Farm. Ripley was a prominent member of the Transcendental Club of Boston whose members followed the German philosophers Kant and Hegel in believing in the supremacy of mind over matter. Moreover Ripley had long had a desire to organize a settlement along socialistic lines. Mrs. Ripley was much in sympathy with her husband's advanced ideas.

(Continued on page 158)

Do the Taxpayers Want Intellectual Eminence?

Don't Blame the Teacher for a Faulty School System. Environment Conducive to Excellence in Education Is, Basically, the Taxpayers' Responsibilty

By BERTHA S. W. DODGE

No nation faces a problem of greater importance than the proper education of its future citizens. As the bumper crop of postwar babies reaches the primary and secondary schools and matriculates into college, vast expansion of our educational facilities are called for at all levels of instruction. Most important of all, however, is that the quality of education shall not suffer as the quantity is increased. Yet this could happen; indeed, serious inroads have already been made in this direction.

The National Science Foundation reports that "at a time when high school population is rapidly increasing, the number of college graduates completing standard requirements to teach high school science and mathematics has decreased from a high of 9,000 to an estimated 4,000 in science, and from a high of 4,000 to an estimated 2,300 in mathematics between the years 1950 and 1954."

It is clear that the teaching profession has not attracted sufficient numbers of devoted and well-qualified persons into whose hands the education of the nation's children is entrusted. Still, the present trend can be reversed – provided the calling is made sufficiently attractive to those who would choose to enter the teaching profession.

More money – for additional schools and for more and better teachers – is not the only crying need; probably it is not even the most urgent element required to put the nation's little red schoolhouse back in order. What is desperately needed, however – as the personal experiences in the accompanying article testify – is the re-establishment of a school environment, throughout the United States, conducive to high educational standards, and a willingness to tackle this problem at the community level.

I LOOKED down the line of backs bent in an earnest endeavor that even the stifling June heat could not abate. "All accounted for," I told myself as I checked over the class list. Yes, all accounted for, but not all present. Tommy Earle would not be taking any of his final examinations this June. He lay in our County hospital undergoing treatment for severe burns he had recently received in the chemistry laboratory where, according to his almost inviolable custom, he had deliberately disobeyed orders, helped himself to forbidden materials, and mixed them according to that diabolical knowledge that even the poorest chemistry student seems to have no difficulty in mastering. Fortunately Tommy, whose misfortune had long been overdue, had lost no more than skin which grafting would eventually replace. Fate was kinder to him than to a more recent student who had blown his hand off in the same school – but, thank God! under another teacher.

And then, as I put down the class list, I saw her – a great rawboned woman filling the doorway in so bellicose a posture that instinct warned me who she was.

"I'm Mrs. Earle," she announced angrily, "I've come to get Tommy's things."

Instinct further warned me that she had come to do no such thing, but I tried to convey to her the idea that I would be glad to help after the examination was finished.

". . . and now that I'm here," she interposed loudly, "I want to tell you what I think of you as a teacher."

So I stood there while the youngsters before me cringed visibly and listened to a noisy tirade such as, it slowly dawned upon me, teachers must often steel themselves to hear. I was, I gathered, a bad teacher not because she had noted (as well she might had she been better informed) large gaps in her son's learning but because, despite my every effort to circumvent him, Tommy had finally been successful in burning himself badly.

"We pay high taxes in this city," she concluded angrily, "High taxes! And we expect good teachers!"

I, too, was angry – not so much at the epithets she had heaped on me as at the idea that relatively defenseless teachers must frequently be exposed to such a scene. For I was only a substitute, called in to cover an emergency when the regular teacher had departed summarily for military service. It was beginning to dawn on me why he had not sought deferment. I was quite new at the game, and very indignant.

"And now Mrs. Earle," I countered icily, "that you have finished telling me what you think of me as a

teacher, let me tell you what I think of you as a mother – to bring up a son incapable of obedience."

"But that's your business," she replied in accents of utter sincerity, "to make him obey – that's what we hire teachers for."

It left me speechless. It still leaves me speechless. For what Mrs. Earle in her outspoken anger had proclaimed – what I as a teacher had listened to – is what, I now realize, innumerable teachers in innumerable schools across our country have to face, by word or by implication, day after day.

Quite literally that was my baptism of fire. As the passing years brought less pressing preoccupation with domestic affairs, an increasing awareness of and interest in educational problems, combined with a master's degree from M.I.T., have made of me a sort of free-lance teacher of science. Only a resolute refusal to meet state requirements in courses in education has made me relatively immune to requests to accept full-time employment as a science teacher in one or another of the secondary schools within easy access of the place in which I live. It is hardly the Mrs. Earles of this world that have kept me – as they keep any number of well-trained people – from filling the crying need for teachers; any teacher can cope with a dozen or more Mrs. Earles, in a suitable environment. General conditions, built up through the last few decades, have made the Mrs. Earles the noisily indignant, self-assured adversaries they now are. These general conditions, where high standards of education, ethics, and culture have given way to an easy-going philosophy in which all things are reduced to the same level, cannot be coped with by the individual teacher.

The Mrs. Earle incident, just described, occurred in one of the best high schools, if not the very best high school of the state; one whose certification of graduates is accepted by all colleges. The school is in a relatively prosperous and highly taxed community. But that cry – "We pay high taxes!" – which in my pristine innocence seemed completely irrelevant is repeated in all communities, large or small. With that cry, outraged mothers progress from teacher to principal to superintendent and, finally, to the school board members who are all too conscious of their dependence on popular vote.

And how are such complaints dealt with? Not long ago one of my young neighbors, who is an enthusiastic teacher of mathematics in a remote suburb, was approached by his superintendent. The teacher was requested to raise the grades, worked out with so much thought, so that there would be no failures in his class. The reason? An impending school board election.

Harold M. Lambert

Many modern high schools have physical plants whose buildings and facilities rival – or outdo – those of colleges. Yet for all their egregious splendors, modern high schools too frequently operate in an environment that fails to emphasize excellence in education.

A few years ago, it was my privilege to witness the conference between the school superintendent of another, smaller suburb and the indignant mother of a notorious problem child who had received a failing grade in English. I was there in a sort of semiofficial capacity because I had agreed to help the superintendent get his books in order. So he turned to me and asked me to get Billy's folder.

"Ah, yes," he murmured as he perused it sadly, "Billy hasn't been a distinguished student but up to now he hasn't failed in anything. Miss Nelson is the first to give him a failing grade. She's new here you know. We get the best we can, Mrs. Smith, with what funds we have. But if Billy had the *right* teacher, there would be no problem at all – he'd *want* to study – why you'd have to tear him from his books."

Mrs. Smith smiled happily as the experienced hypocrite assured her of her son's great potentialities. Even in the brief glimpses I had had of the intransigent Billy I knew these potentialities could never exist. Because I was personally acquainted with the teacher in question, I was able to get her side of the story, without breaking any confidences.

"There's so much talk of increasing teachers' salaries," she exclaimed one day in a moment of black discouragement, "and God knows there is need for this. But it's not money alone that makes me think of trying something else. I want to *teach*. If only I could teach without having to spend all my time keeping order among students who have not the slightest desire to learn, I'd be glad for the experience I could get in even so small a place as Hilldale. I'd look to the rewards later. It's *not* the money."

What is true in the teaching of English is even more important in subjects for which laboratory work is an essential part of the instruction. No salaries that any school board is likely to dream up will make a good teacher of one who lacks enthusiasm both for his subject and for imparting it to younger eager minds. Nor will any salary, no matter how large, compensate such a teacher for being hampered in his teaching. Denied an opportunity to teach, a teacher well trained in science can easily obtain lucrative employment in industry. I fear we shall soon find ourselves up against the paradox that the better college students are trained for teaching science in secondary schools, the fewer good science teachers will be found in those schools. For only those too old to change their means of livelihood and the inferior younger ones – those who find no cause for rebellion against the conditions under which they must work – can continue indefinitely in a profession which is fast losing its dynamic appeal.

It is not difficult for one who has been around in a variety of schools, and has even had some experience teaching college freshmen, to name a number of reasons why this is so. From personal experience alone, it would be very hard indeed to rate these reasons in order of absolute importance; it is quite impossible to claim that none had been overlooked. But high on the list and encompassing most of the others is the question of discipline.

It is all very well to say that a good teacher can maintain discipline. In all but the rarest cases she can – if that is to be her main function. Granted a fair smattering of not-too-reluctant students and a shrewd instinct for which offenses to notice, and which to ignore, a teacher can maintain a reasonable semblance of order. When faced with a notoriously difficult situation, I myself have done just this. But I did not teach at the same time. And when I rebelled against the restraint that was more irritating to me than to the students and tried to teach, I came smack up against one of those Billy Smiths who had no desire to learn anything himself and was determined that no one else should better his record. He admitted he did not want to be in school, that he was only marking time until he was old enough to get into the Army or find a job in industry – which, incidentally, he was counting upon his high school diploma to facilitate. That document, I gathered, was to come as a reward for enduring four years of boredom.

Most of his obnoxious activities were not quite serious enough to involve the principal who, I knew, would resent being consulted on anything less than a major offense. Finally when something serious came up and I sent the offender to the principal's office, he left my room grinning broadly, and returned a quarter-hour later grinning even more broadly. I realized at once that he had had a pleasant little discussion of his personality and, by innuendo at least, my own.

The next time I sent a pupil to the principal, I put teeth in my directions. This particular lad murmured some especially insulting and obscene epithet in such a conversational tone that, for an instant, I doubted my ears. Most of his classmates, I also noted, were too preoccupied with other matters to have grasped the full import of his words. Only his slyly triumphant grin convinced me that I had heard aright; evidently he expected to provoke me to underline his comments with a prompt and public rebuke.

"You will please take this note to the principal," I murmured in a conversational tone to match his own, adding, as the lad stood up, "and take your books. You're *not coming back*."

To his everlasting surprise, he did not come back. For I alone of all the teachers in that school was in a position to state categorically, "Either he goes or I do!" I was a substitute teacher and so without a contract whose breaking would damn me forever in this state, and possibly in all others as well.

In the problems with which I had to deal, I was no different from the other teachers. Observation and conversation told me that, as a substitute teacher, I might find my problems more immediately acute than the others but that all of them were conscious of struggling against the same handicaps. No – not quite the same. For my subject was a laboratory science and how can one even hope to conduct successful laboratory periods if, as soon as one's back is turned, some Tommy Earle is slyly setting aside enough of his reagents to prepare an interesting little batch of gunpowder, a few match heads to be left on a neighbor's porch, some pleasantly noisy nitrogen iodide or maybe just innocently secreting a few cubic centimeters of the taxpayers' concentrated nitric and sulphuric acids – to be combined later with some glycerin easily purchased in the corner drugstore? I

(*Continued on page 152*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Stever Becomes Associate Dean

H. GUYFORD STEVER, chief scientist of the Air Force, has been appointed associate dean of the Institute's School of Engineering, James R. Killian, Jr., '26, President, announced in December. Dr. Stever has also been promoted from associate professor to professor of aeronautical engineering.

Dr. Stever has been on leave from M.I.T. since last February, when he went to Washington for one year as chief scientist, in which capacity he serves as adviser to the Chief of Staff and the Secretaries of the Air Force. His leave has been extended and he will return to M.I.T. in June. In making this announcement President Killian said:

In his new capacity, Dr. Stever will participate with C. Richard Soderberg, '20, Dean of the School of Engineering, in the leadership of the school and he will also continue as a professor, part time in the Department of Aeronautical Engineering. He has made numerous and important contributions to the field of aeronautics, both in relation to supersonic aerodynamics and electronic guidance problems.

Born in Corning, N.Y., in 1916, Dr. Stever received his A.B. degree from Colgate University in 1938 and his Ph.D. in 1941 from California Institute of Technology, where he did significant research on cosmic rays and electronics for Geiger counter experiments.

After receiving his doctorate, Dr. Stever came to M.I.T. as a member of the staff of the Radiation Laboratory, where he rose rapidly to a position of responsibility in the development of radar. From 1942 to 1945 he was scientific liaison officer in London representing the National Defense Research Committee in work on radar and guided missiles. Dr. Stever returned to the Faculty of M.I.T. after World War II, becoming an assistant professor of aeronautical engineering in 1946 and associate professor in 1951.

"Canticle of Freedom"

COMMISSIONED by the Institute to be written for the dedication of the Kresge Auditorium, the "Canticle of Freedom" – Aaron Copland's piece for orchestra and chorus – had its first New York performance at Carnegie Hall on November 10. Leonard Bernstein conducted the Symphony of the Air, which is the successor to the National Broadcasting Company orchestra, at which Mr. Copland's work was performed.

Writing in the New York *Times* for Friday, November 11, 1955, under the heading "Music: Premiere of Copland Work," Howard Taubman recalled that the piece was commissioned by M.I.T., "an institution that knows the relationship between science and the humanities," and commented that the " 'Canticle of Freedom' has a portentous, ceremonial opening, which is fine to show off instrumental virtuosity. Then it goes on to the substance, which is agreeable in content and skillful in working out."

Coming Events

TECHNOLOGY flavored meetings which Alumni will wish to attend include: the Boston Midwinter Meeting to be held at Walker Memorial on Wednesday, February 1; the Midwest Regional Meeting to be held at the Missouri Athletic Club in St. Louis on Saturday, February 4; and a West Coast Regional Meeting to be held at the Ambassador Hotel in Los Angeles on Saturday, March 17. Members of the M.I.T. staff will discuss current events at the Institute.

Additional information for the St. Louis Conference is available from Robert J. Joyce, '28, 802 Chestnut Street, St. Louis 1, Mo. For the West Coast Conference, William H. MacCallum, '24, 880 Winthrop Road, San Marino, Calif., can supply information to those who wish to attend.

M.I.T. Photo

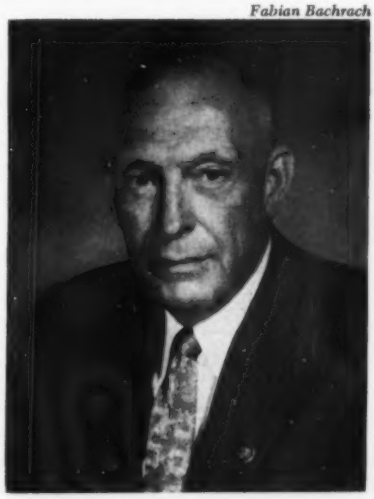
◄ H. Guyford Stever . . .

now on leave of absence and serving as Chief Scientist of the Air Force, will return to M.I.T. in June to assume the new post of Associate Dean of the School of Engineering.

Joseph W. Barker, '16 . . . ►

President of the Research Corporation, and recently elected President of the American Society of Mechanical Engineers, will be dinner speaker at the M.I.T. Regional Conference in St. Louis on February 4. President Killian and members of the Institute's Faculty will also speak.

Fabian Bachrach



M.I.T. Photo

In the Schell Room on the fourth floor of Sloan Building, Mr. Sloan discusses the function of the School of Industrial Management with students and Faculty members of the School.

Students Interview A. P. Sloan

ALFRED P. SLOAN, JR., '95, chairman of the Board and former President of the General Motors Corporation, held an interview with students and Faculty members of the School of Industrial Management in the Sloan Building on November 30. Mr. Sloan was introduced to the meeting by E. P. Brooks, '17, Dean, following introductory remarks by Paul B. Readett, Jr., President of the Graduate Management Society.

Answering questions of a student panel, Mr. Sloan gave his views on the unique function that the School of Industrial Management is providing in training future leaders of industry. He also spoke on the interrelationship of the university, industry, and the community – drawing on his experiences with General Motors Corporation for the purposes of illustration. The chief problem of industries today, Mr. Sloan felt, is that of keeping ahead of competitors. He cited the case of changes in automobile models which the General Motors Corporation makes each year in order to meet competition and best suit the tastes of the consumer.

In dealing with the questions on the part played by an educational institution in training young men, Mr. Sloan emphasized that the greatest contribution could be made by teaching students to think for themselves, and to analyze accurately problems that arise in their lives. He went on to explain that such facility would serve a young person well no matter what career was chosen. Following the interview, Mr. Sloan met members of the Faculty, as well as graduate students of the School of Industrial Management at a reception held in the Schell Room.

Mr. Sloan's visit to the School was sponsored by the Graduate Management Society and M.I.T. Management Association. It was part of the organizations' monthly program of meetings with outstanding leaders of industry.

Repetitive Roster

REGISTRATION figures at the Institute climbed to a high of 5,648 (including graduate students) in the fall of 1955 when 948 freshmen registered in the Class of 1959. As of October 24, the total for freshmen and upperclassmen was 3,657; then the Graduate School enrollment increased the figure to the 5,600 mark which was the highest since 1947–1948 when veteran registration was heavy.

Participating in the traditional Freshman Week End activities were 34 first-year students whose fathers are Alumni of M.I.T. To this group perhaps orientation in the ways of the Institute was made somewhat easier because of familiarity gathered through family experience. Listed below are the sons (and one daughter) of Alumni enrolled in the Institute's Freshman Class:

Student	*Parent*
Michael E. Ash	Maurice L. Ash, Jr., '26
Bradford Bates	Philip K. Bates, '24
Marc Brown	Abraham Brown, '24
Thomas S. Budlong	Mortimer C. Budlong, '28
Charles S. Coffey	Timothy P. Coffey, '32
Peter E. Coffey	Timothy P. Coffey, '32
David L. Coleman	Albert F. Coleman, '31
Henry R. Couch, Jr.	Henry R. Couch, '20
Robert W. Grass	Albert M. Grass, '34
Carol J. Greenough	Russell F. Greenough, '22
Edward C. Haines, Jr.	Edward C. Haines, '24
Charles W. Harper, Jr.	Charles W. Harper, '33
Joseph Hartshorne	Edward Hartshorne, '28
William McC. Hawkins	John C. Hawkins, '34
Gardner W. Hicks, Jr.	Gardner W. Hicks, '33
Edwin B. Hooper, Jr.	Edwin B. Hooper, '40
Lester C. Hopton, Jr.	Lester C. Hopton, '26
Michael D. Intriligator	Allan Intriligator, '30
David P. Keane	Edward C. Keane, '22
Thomas M. Kimball	Robert M. Kimball, '33
George S. Lewis	Davis D. Lewis, '31
Richard C. Lyons	Charles E. Lyons, '28
William M. Marcus	Richard J. Marcus, '32
George A. Morton, Jr.	George A. Morton, '26
David J. Paul	Samuel Paul, '35
Henry M. Peskin	Leonard C. Peskin, '29
Philip M. Richardson, Jr.	Philip M. Richardson, '26
William A. Ross	Herbert F. Ross, '32
Gustave M. Solomons, Jr.	Gustave M. Solomons, '28
Charles O. Staples	Elton Staples, '26
David B. Tuttle	Thomas W. Tuttle, '25
Donald B. Vaughan	Donald G. Vaughan, '25
Robert A. Williamson, Jr.	Robert A. Williamson, '26
Stewart W. Wilson	Richard MacC. Wilson, '30

On Personnel and Jet Aircraft

PRESIDENT DWIGHT C. ARNOLD, '27, opened the 313th meeting of the Alumni Council held at the Faculty Club on the evening of Monday, November 28, attended by 136 members and guests. Following approval of the minutes of the meeting of October 31, Theodore T. Miller, '22, chairman of the Alumni Fund Board, reported that 3,342 Alumni had contributed a total of $95,000 to this year's Fund. These early figures represent 36 per cent of the total number of contributors, and 40 per cent of the total amount contributed to the 1954 Alumni Fund.

As Secretary of the Association, Donald P. Severance, '38, reported that seven visits to local clubs by as many different members of the Institute's staff had been made between November 3 and November 18. In addition to Donald W. Kitchin, '19, and D. Reid Weedon, Jr., '41, who had previously been named chairman and deputy chairman, respectively, the Executive Committee has nominated the following subcommittee chairmen for Alumni Day, 1956; *Registration*: Wolcott A. Hokanson, staff; *Conference*: Egon E. Kattwinkel, '23; *Special Invitations;* Philip A. Stoddard, '40; *Luncheon:* John P. Larkin, '26; *Banquet:* Oscar H. Horovitz, '22; *Ladies:* Mrs. Joseph J. Snyder; and *Gifts and Prizes:* David W. Skinner, '23. The Secretary also reported briefly on plans for two Regional Conferences.

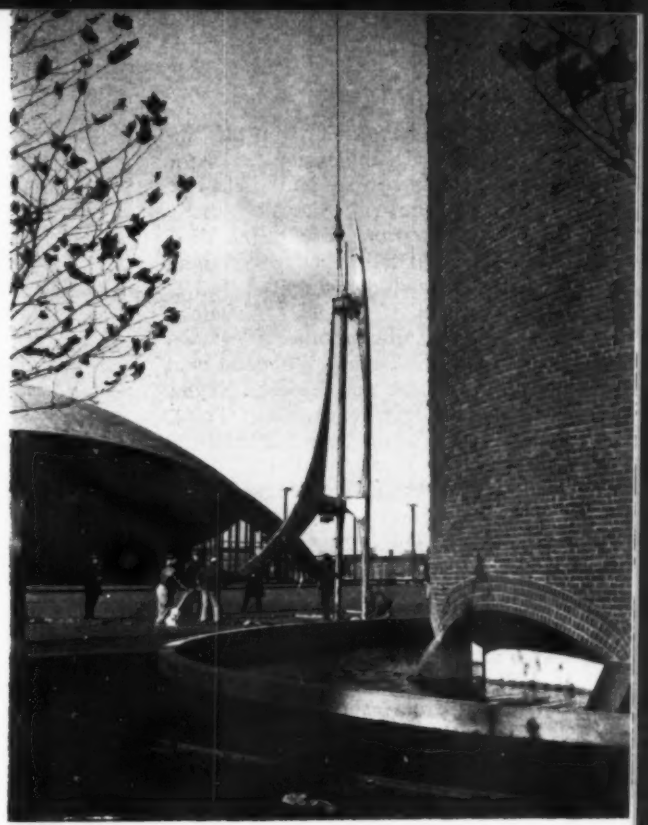
Chenery Salmon, '26, chairman of the Midwinter Meeting Committee, announced that, in order to avoid conflict with the St. Louis Conference, the date for the Boston Midwinter Meeting had been changed to Wednesday, February 1. Following a steak dinner a panel of Technology Faculty members, with John E. Burchard, '23, Dean of the School of Humanities and Social Studies, as moderator will take part in the program at Walker Memorial.

Vincent T. Estabrook, '36, chairman of the Boston Luncheon Club Committee, invited Council members to the regular meetings at the Olde Oyster House, 41 Union Street, Boston.

Following the business portion of the meeting, Council members heard Albert F. Sise, Personnel Officer at M.I.T., speak on "The Changing Requirements of Personnel Administration at M.I.T." and William R. Hawthorne, '39, Hunsaker Professor of Aeronautical Engineering, speak on "Power Against Gravity."

Mr. Sise outlined the growth of the Institute's employee personnel and the problems which this growth has introduced. In the past 15 years, the number of M.I.T. employees has increased from 1,300 to 6,500, of which 2,000 are represented by four different unions. These people are engaged in a wide variety of work, and often come into contact with employees of other organizations where working conditions differ somewhat from those at the Institute. The need for the Institute to become better acquainted with the thinking of its employees and, in turn, to acquaint its employees with some of its problems and objectives was clearly brought out.

In a talk illustrated with slides, Dr. Hawthorne discussed the development of aircraft powered by gas turbines, whose great advantage is their comparatively low weight. Turbines consume large quantities of fuel, however, and efforts are being made to reduce fuel consumption for a given performance. This can be done by increasing the pressure ratio, and by increasing the operating temperature. He discussed the use of jets in helicopters with ram jets operating at the tip of helicopter blades and with a central gas turbine engine whose output is piped through the rotor so that the jet streams leave the propeller blade much as water spray leaves the conventional lawn sprinkler. New power plants permit vertical take-off and landing of air-borne vehicles, and undoubtedly will open up new modes and speeds of air travel.

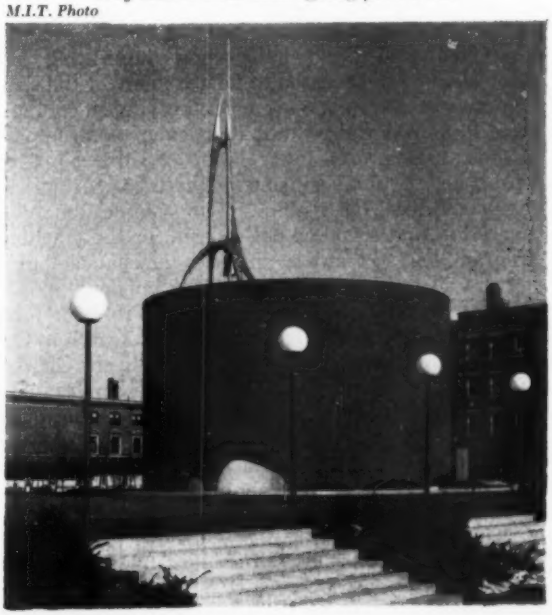


M.I.T. Photo

An all-aluminum structure 45 feet high and put together by means of bolts and welded joints was erected atop the M.I.T. Chapel in mid-November. The bell tower and spire, shown in the two illustrations on this page, was designed by Theodore J. Roszak of New York.

According to Mr. Roszak, the notion of verticality, which is the dominant note in the over-all emphasis of the tower, expresses spiritual aspiration. The three vertical members symbolize the three denominations that share the common edifice. The frontal arch will contain the bell which was cast in the M.I.T. Metals Processing Laboratory and is now undergoing final tests.

M.I.T. Photo



Sailing Summary

WHEN M.I.T. sailors won the National Championship at New London last spring, and their two top-point winners – Alain J. de Berc, '55, and Fred A. Brooks, Jr., '55 – were graduated, Tech's winning streak seemed doomed. But M.I.T. Commodore J. Nicholas Newman, '56, and H. William Stiles, '57, placed second in the Danmark Regatta held on the Charles, and won the Nevins Memorial Trophy at Kings Point, N.Y., and later the Potomac Frostbite Regatta at Washington, D.C. They also won the Oberg Trophy for Greater Boston Championship and the Fowle Trophy in the New England Racing Championship.

Donald M. Fellows

Moreover, the freshman squad became freshman champions of New England, which was equal cause for satisfaction among the sailors.

Sailors de Berc, Newman, and Stiles visited England and Ireland last summer as members of a combined North American University Team. The American team had 19 matches, and won 15, but lost the most important match for the British-American Trophy by a close margin. In England, the group participated in the famous yachting event, Cowes Week, and entered three boats in the International Five-O-Five Class.

Chemical Abstracts

TWENTY Faculty members of the Department of Chemistry met with members of the Department's Visiting Committee at the Institute on March 6, 1955, for a review of the Department's activities.* During the past year, Walter H. Stockmayer, '35, Professor of Physical Chemistry, David N. Hume, and C. Gardner Swain, Associate Professors of Chemistry, were on leave of absence for study in Europe. In their absence, courses in First Year Chemistry, Third Year Physical Chemistry, and Advanced Organic Chemistry have been given by younger members of the Department – Carl W. Garland, Frederick D. Greene, 2d, and John S. Waugh, Assistant Professors of Chemistry. The Committee found these reports interesting and stimulating and discussed at length many of the suggestions which were made concerning subject content, student interest and attitude (particularly on the part of nonchemists), and interrelation of subject matter with other required subjects in the first year and in the chemistry curriculum. The Committee was pleased to find so much enthusiasm for the teaching program, and so many suggestions for changes offering promise of improvement in the curriculum.

The Committee heard reports from Professor John C. Sheehan on "Some Impressions of Research in Organic Chemistry Abroad" and from Professor Charles D. Coryell on "Some Impressions on Research in Nuclear Chemistry Abroad." Professors Sheehan and Coryell were on leave of absence in 1953–1954 and had the opportunity to visit many foreign educational institutions and research laboratories.

* Members of this Committee for 1954–1955 were: Crawford H. Greenewalt, '22, chairman, Godfrey L. Cabot, '81, Edwin D. Ryer, '20, Robert L. Hershey, '23, Eger V. Murphree, '23, John G. Kirkwood, '29, M. Gilbert Burford, William M. Holaday, and Paul L. Salzberg.

It was encouraging to note that while the number of advanced undergraduates majoring in chemistry both at the Institute and throughout the country in 1954–1955 was small, a comparatively large number of first-year students at M.I.T. have indicated that they intend to major in chemistry.

The Committee discussed at some length changes which are to be made in the First Year Chemistry course in 1955–1956 as a result of a study made by a departmental committee, and the pros and cons of offering instruction in different kinds of elementary chemistry or separate sections for chemists and nonchemists. It was generally agreed that the best policy was to offer a single fundamental and rigorous course such as is now being given, with a special optional section for those who are particularly interested in advanced work.

There was a discussion of the financial problems of students in the Graduate School, of the National Science Foundation, and National Institutes of Health programs, industrial fellowships in Chemistry and their use, grants-in-aid for research, and educational advantages of teaching and research assistantships; also the needs for funds to encourage fundamental research or long-range grants to promising young men (of the rank of instructor or assistant professor) interested in academic careers.

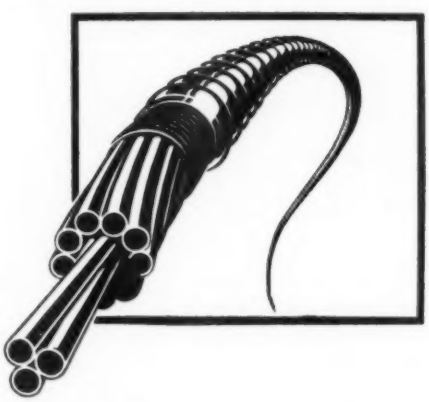
The Committee endorsed the policy of the Department in emphasizing creative thinking and research at both the undergraduate and graduate level, and noted that the diversity of research interests of its staff members was a source of strength in the Department.

The Committee's report was considered by the M.I.T. Corporation at its meeting on June 10, 1955, and by the Executive Committee of the Institute on October 21. The report was received for publication in The Review on November 8.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Copper tube is used for hot and cold water lines, radiant panel heating, drainage lines, and to carry fuel or lubricants in automobiles and machine tools. Those are some of the conventional applications. However, during the last few years a new market has developed for this tube. You might like to hear about it. It is in pneumatic or hydraulic recording and control systems. One end of the tube is located at the point where temperature or pressure must be observed, and the other end is connected with a dial, a recording device, or an automatic controller. The tube may be filled with air, an inert gas such as nitrogen, or a fluid. The tube has the great advantage that it carries no electricity, and thus can be installed in places where a spark might cause an explosion, as in a plant handling combustible gases or chemicals.



Originally the idea of using copper tube for this purpose was carried out by running separate lengths of bare tube from the originating points to the panel board. This meant considerable care in installation, and it was also necessary to run the tube where it would not be subject to mechanical damage, or to protect it otherwise. Then a new development appeared: cabled tube. A way was found to put as many as 19 quarter-inch copper tubes in a single armored cable, so that instead of rigging 19 separate runs of tube, just one cable is run, the tubes being fanned out at each end as required. Installation time is cut markedly, and the armor provides self-protection. Cable runs as long as 1,000 feet are possible without joints. The tubes are color-coded.

Just to give you an idea of the usefulness of tubes in cables, here are a few of the applications in the plant of just one public utility: boiler temperatures, main and reheat steam pressure, boiler feed and condensate pump pressure, condensate temperature, fuel oil and gas pressures, liquid levels, tide level, boiler drum water level, control of fuel feed, draft dampers, and numerous other controls.

This is a fast-growing use for copper tube, and while it will not match the demand for tube in commercial structures and private homes, nevertheless it is an important subject for industry and instrumentation engineers. In fact, a couple of years ago we thought that cabled tube had enough news interest to justify running an advertisement about it. Revere does not make cabled tube, but a Revere customer does, so we reported the matter as a service to industry. Mail began to arrive immediately, asking for further information. It is still pouring in, as the result of a second advertisement on the subject, appearing less than a year ago. American business certainly watches the advertisements for news it can use.

This is an example of imagination applied to a product that literally is as old as the pyramids. We have said in the past that "copper is the metal of invention," because it is so adaptable to man's genius. But there are many other materials, not merely metals, but such substances as glass, wood, plastics, fabrics and fibres, that also respond to an inspired touch. Why not get in touch with your suppliers, and let them know your problems? Perhaps they can arrive at a new way to use an old product, or even develop something new to solve an old problem. Just let it be known what you need, and watch people respond!

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INTELLECTUAL EMINENCE

(*Continued from page 146*)

put the question to the reader but I make no attempt to answer it.

An easy solution would be to exclude an obviously undisciplined Tommy from class before he can accumulate the ingredients of one of his lethal concoctions. But Tommy's parents – remember – pay high taxes. Tommy's personality might also be warped by being denied access to the class. If Tommy wants to take chemistry, isn't that what his parents are paying high taxes for? Of course the *right* teacher would be able to handle him. Why the lad has been crazy about chemistry ever since Uncle Job gave him a chemistry set way back when. . . . So Tommy ends up in a hospital bed. He will recover. The lad who blew his hand off lost – alas! – more than his hand. For he was a gifted violinist with a probable future on the concert stage. What, I ask, has that accident done to *his* personality?

Well-Integrated Mediocrity

Worst of all, what is this tragic situation doing to generations of willing students who come out of high school with backgrounds that become more and more meager each year? Their parents are taxpayers too, like those of the girl who, after a year of high school chemistry, seemed unable to grasp the simplest chemical formula.

"But didn't you learn that in high school?" I queried aghast.

"Oh, we had a vitalized course in chemistry," she answered airily. What vitalized chemistry is, she was able to explain no more than I.

My guess is that it is just another of those clichés with which present-day educators fill their speech and cover their inadequacy. Youngsters don't just grow up any more – they go through one "phase" after another, all of which are listed and catalogued in educational psychologies. Social problems are "situations" which must be handled so as to produce "well-integrated" personalities. It's a fascinating language and probably describes phenomena as well as any other. What I take exception to is the attitude that by naming a phenomenon you have solved the problem which may be inherent in it. Such an attitude is more likely to complicate than to solve educational problems.

Assume, now, that a science teacher has managed to maintain perfect discipline in class, has managed to impart considerable information to a large percentage of his students, and has even managed to make failing grades stick where they belong. Assume moreover that he has found adequate means for dealing summarily with the Mrs. Earles who are ever ready to pounce. Can he relax? Not at all.

A teacher's time is rarely his own. Though he, or she, may have had an exhausting day between laboratory preparations, instruction in both classroom and laboratory, and faces the evening with a pile of papers that, if his instruction is to be effective, should be gone over carefully, he will still be expected to

(*Continued on page 154*)

One of Combustion's two plants at Chattanooga, showing new facilities: (A) nuclear building housing specially designed equipment for the manufacture of reactor components, (B) 360-foot double craneway and wharf permitting water shipment of units exceeding 300 tons and (C) mechanized foundry.

Again in 1955

the word for COMBUSTION was GROWTH

Since 1950, Combustion has increased its productive capacity by more than 50 per cent. This has involved expansion of all five of its domestic manufacturing divisions as well as its Canadian division. It does not, however, include the new nuclear facilities and mechanized foundry referred to in the caption of the picture. These were 1955 projects which are now either in operation or well along toward completion.

NEW NUCLEAR FACILITIES

In addition to the new facilities depicted above, Combustion is currently building a Nuclear Engineering and Development Center on a 500-acre tract recently acquired at Windsor, Connecticut. This center will comprise an Administration Building, Critical Facility, Chemical and Metallurgical Laboratories and buildings equipped for the fabrication and assembly of atomic fuel elements. When this program is accomplished about a year from now, Combustion will have the exceptional advantage of being equipped with the personnel and facilities to design and manufacture complete nuclear reactor systems.

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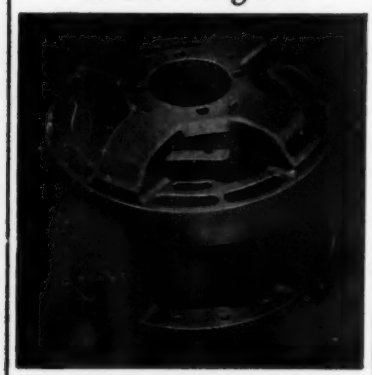

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INTELLECTUAL EMINENCE

(*Continued from page 152*)

participate in any number of extracurricular activities. He will serve on this or that school or citizen's committee, conduct a science club, perhaps coach some sport, maybe continue with some adult education project at night. Any one of these activities would be good, and quite sufficient. The total of demands on a teacher's time is simply staggering. No one seems to realize that though the hours when school is in session are fewer than those of the average taxpayer's business day, the strain is infinitely greater. Yet the teacher daily works at his trade a total of hours that would make the average taxpayer howl against exploitation.

Why Don't Teachers Complain?

"Why doesn't the teacher also howl?" someone will ask. That, unfortunately is just what some of our best teachers are beginning to ask too.

Even after the Tommy Earles and Billy Smiths have served their time at school and have received the diplomas which, no matter how meaningless in terms of subjects mastered, will enable them to enter upon the kind of employment they think they want – even then the teacher cannot rest quietly. For the diploma over which the teachers now have so little control is regarded as a sort of commitment on the teacher's part.

Thus, as Tommy continues to follow his cheerful path of irresponsibility, the teacher again takes the blame. Tommy, of course, has developed no self-discipline, intellectual or otherwise. Whose fault but the teacher's? Tommy rarely took a school book home to study, never did assigned outside reading, frequently absented himself from school without serious parental reproof. So if Tommy cannot read with true comprehension, cannot spell properly, cannot write an acceptable letter, cannot use a dictionary, whose fault but the teacher's? It is so easy to place the blame on "progressive" education, but is not progressive education what the "progressive" taxpayers wanted?

The teacher knows only too well that today's high school students are capable of learning for they seem to be reasonably well informed in areas where their interests lie. The Tommys and Billys can talk all too glibly of hot rods, but try and make them master the use of the simplest algebraic formula in mechanics!

(*Concluded on page 156*)

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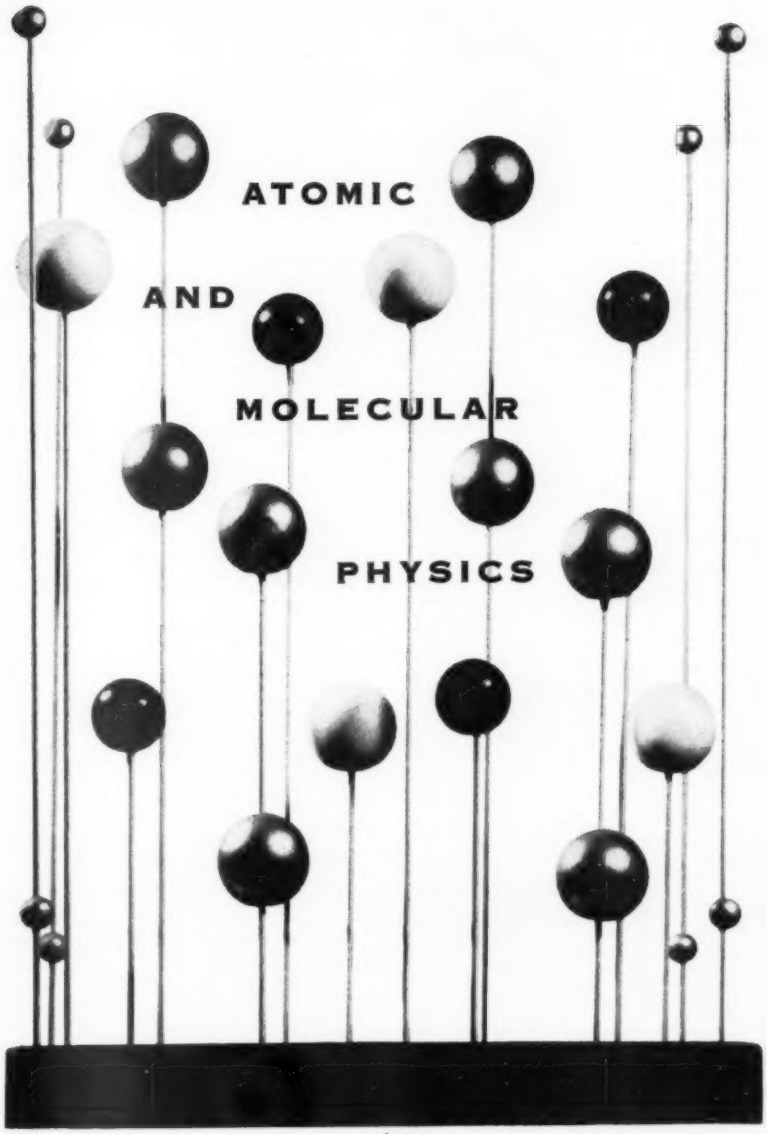

Molecular structure model, courtesy California Institute of Technology

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INTELLECTUAL EMINENCE

(Concluded from page 154)

"Interplanetary travel" rolls smoothly off the tongues of lads who could not, for the life of them, explain what is meant by "equinox." Jet propulsion and supersonic speeds are commonplace to these youths whose understanding of the basic principles of light, heat, sound, and electricity is conspicuous by its absence.

The "A" Student

We all recognize that even at the elementary level, the mastering of scientific subjects means hard work, self-discipline, and a kind of self-dedication that now appears to be outmoded. Today the function of the school is not to encourage these qualities, but to develop "well-integrated personalities" (whatever that may mean) and to make little "leaders" of youngsters who seem to be incapable of directing their own actions effectively. So the tendency grows for students to take the easy way out, to study snap courses where they never need to crack a book — and how many saddened students of trigonometry have told me that they got "A's" in high school geometry without ever having had a homework assignment! As a past high school teacher, I refuse to impute the blame to the teachers. For conscientious teachers must sadly watch the creeping paralysis of learning which teachers, unaided, can do little to cure.

Admittedly the above account is based on limited personal experiences, although it is bulwarked by conversation with and observation of many others. No doubt more thorough statistical studies would yield a more accurate, although not very divergent, picture. But no questionnaire answered by educators and no study of statistics however comprehensive will solve a problem that is, as Mrs. Earle knew so well, basically one that the taxpayers themselves must handle, and solve!

If the taxpayers want good education for their youngsters they must be better informed as to just what constitutes good education. A nation which has so great a stake in its scientific personnel as the United States cannot afford to leave the education of its young people to chance. Somehow taxpayers must learn where their responsibility meets that of the teachers. They must demand of the schools not only good teachers — and most present teachers could be far better than they are, given half a chance to teach — but also a school environment conducive to high educational standards. I do not refer to the schools' physical plants which, often, are far finer than many a college has to offer, but rather to the spirit of the community, particularly with respect to its attitude on intellectual discipline.

As the taxpayers clamor, the ever sensitive school boards must respond. So, also, will school principals and local superintendents and, eventually, the remoter state and county superintendents. But the taxpayers must want, must be able to recognize and know enough to demand, the kind of education our young people should have if our nation is not to lose its intellectual eminence.

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BROOK FARM

(Continued from page 143)

She was a brilliant speaker, a clever writer, and the daughter of Francis Dana of Cambridge, a former attorney general of Massachusetts.

The Ripley family spent the summer of 1840 at the farm in West Roxbury, owned by Charles and Maria Ellis. They found it to be a very pleasant farm, with a successful milk business, located near the Charles River about three miles north of Dedham. A brook flowed in front of the farmhouse and emptied into the Charles River. The soil was not very rich and had a substratum of sand and gravel but there was an abundance of grass, well suited for a dairy farm. It seemed to be a very good site for Ripley's cherished settlement. He talked over his plans with Ralph Waldo Emerson and other friends and they decided that $50,000 should suffice for the project, of which $30,000 should supply land and buildings for 10 families. They proposed to raise the required sum by forming a joint stock company, the shares of which would be secured by a mortgage on the real estate. Shares were to be priced at $500 each and to bear interest at 5 per cent.

In the winter of 1840-1841, Mr. Ripley decided to buy the farm and be responsible for its management. He paid $10,500 for the farm containing 170 acres. The following were elected trustees: George Ripley; William B. Allen, a young farmer from Vermont; Nathaniel Hawthorne, the well-known novelist; and Charles A. Dana, a young Harvard student who first achieved fame as editor of the New York *Tribune*, and the New York *Sun*, and later became Assistant-Secretary of War under Stanton, and adviser to Lincoln and Grant during the Civil War.

In April, 1841, the Ripley family, Mrs. Pratt and their children, Hawthorne, Bradford, Burton, and a few others took possession of the property, to be joined shortly by Mr. Pratt and Charles Dana. It was decided to set up the new settlement as a co-operative venture in which the members should unite in manual labor and be recompensed for actual work accomplished. The settlement was not planned as an Owen or Fourier organization.

An Association called the Brook Farm Institute of Agriculture and Education was finally formed. Articles of Association were drawn up and officers elected. The signers of the Articles, in addition to the Ripley family, were the Reverend George P. Bradford, Harvard 1825, a son of Gamaliel Bradford of Duxbury; Warren Burton, Harvard 1821, a minister who had served in East Cambridge, Hingham, and Waltham; Minot Pratt, who had been a successful printer in Boston, and Maria J. Pratt; Nathaniel Hawthorne, the novelist; the Reverend and Mrs. Samuel D. Robbins (who although writing for Brook Farm publications were never active in the settlement); David Mack (who later started the settlement at Northampton); George C. Leach, an abolitionist; Lemuel Capen; and the above-mentioned Charles A. Dana, who was destined to take a very prominent part in the development of Brook Farm.

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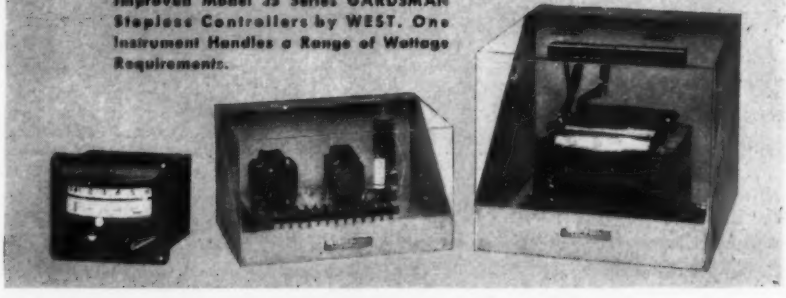

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Dana was the first secretary and chairman of the Finance Committee. He was born in Hinsdale, N. H., in 1819, of the sixth generation from Jacob, one of the four sons of the original Richard who immigrated from England to Cambridge in 1650. His father, who was a very conservative Congregationalist, was not well off and could not afford to send his brilliant son to college. However, by much sacrifice Charles worked his way through Harvard, but not with the approval of his father who, when he learned that his son had been attending some Unitarian services with Harvard classmates, wrote him, "Ponder well the paths of thy feet lest they lead down to the very gates of hell."

Dana was delayed in graduating by severe eye strain, and in August, 1841, applied to Brook Farm for membership with the ideas of resting his eyes, meeting desirable people, and living economically. He was duly admitted and became very popular. He always retained a strong interest in Brook Farm after he became famous, and referred to his association with its members as very stimulating. It was there that he met Horace Greeley, an occasional visitor, who gave him such a successful introduction to the New York newspaper fraternity.

Finances and Management

Shares of the new Association were priced at $500 and were to bear 5 per cent interest. The owner of each share was entitled to the tuition of one pupil in the Brook Farm school in lieu of interest, if he so desired. Other interest was to be paid in the form of new shares. Original purchasers of shares, and the amount of their holdings, were as follows:

Name	*Number of Shares*
George Ripley	3
Sophia Ripley	2
Marianne Ripley	3
Minot Pratt	3
Maria T. Pratt	2
William Allen	3
Charles A. Dana	3
Nathaniel Hawthorne	2
Sarah F. Stearns	2
Charles Whittemore	1

Unfortunately, only about one third of the total sum for these 24 shares was actually paid for at the beginning, and it was a long time before the remainder was collected.

Title to the farm was passed on October 11, 1841, the same day on which Ripley, Hawthorne, Dana, and Allen, as trustees, placed a first mortgage of $6,000 on the property with Daniel Wilder and Josiah Quincy, commissioners of the sinking fund of the Western Railroad Corporation. A second mortgage of $5,000 was placed with George R. Russell, Henry P. Sturgis, Francis G. Shaw, and Lucy Cabot.

(Continued on page 160)

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BROOK FARM

(Continued from page 159)

The School

From the first, educational activities were an important part of Brook Farm objectives, and the school was quickly organized. It was highly successful too, largely as the result of careful planning, the high standing of the teachers, and the unusual character of the students.

The school was divided into three departments: an infant school over which Georgiana Bruce Kirby and Miss Abby Morton presided; a primary department for which Marianne Ripley was responsible; and a six-year college preparatory course. George Ripley taught mathematics and philosophy; Mrs. Ripley, history and modern languages; Charles Dana, Greek and German; John S. Dwight, Latin and music; Anna B. Ripley, drawing; Amelia Russell, dancing; George P. Bradford, belles-lettres; and Orestes A. Brownson, agriculture.

The school was run on very unconventional principles, with no set study hours and with great freedom of intercourse between students and teachers, all of whom joined in the festivities of the group. Students were urged to study for the purpose of learning things of real value and interest, and to create the passion to become well educated. Practically all subjects were elective.

During the brief period of its existence, the school brought together a large number of young people who injected much amusement and heathy pleasure into the group. These included Francies C. Barlow (later a general), George A. Wells (later a colonel), the brothers George William Curtis and Burrill Curtis, the two sons of George Bancroft, James M. Fuller (brother of Margaret Fuller), two popular boys from Manila—Lucas Corrales and Jose Corrales—and several from Havana, Florida, and Cambridge.

The study periods were interspersed with practical instruction and manual labor, with the boys engaging in agriculture, milking, shoemaking, printing, hoeing, wood chopping, and sash and blind making, and the girls in housekeeping, cooking, and kitchen and laundry work. In the evening various entertainments such as cardplaying, music in charge of Dwight Newcomb, and talks by Margaret Fuller and others became popular forms of diversions. Dances, plays, and masquerades gave the young people an opportunity to show their ingenuity.

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Young George William Curtis was a leader in these activities. Dressed as Hamlet, he led a quadrille with beautiful Carrie Shaw who was dressed as a Greek girl. As the melancholy Dane he was perfect in a black-plumed head covering, a glittering rapier, and his melancholy eyes. The Curtis brothers were great favorites and were spoken of as young Greek gods. Thomas Wentworth Higginson, who was sympathetic with the Brook Farm idea, wrote in his *Cheerful Yesterdays*, "Into this summer life there occasionally came delegations of youth from Brook Farm, including the Curtis brothers and Charles A. Dana, dressed in agreeable but peculiar costumes—a kind of hunter's frock of gray-colored chintz belted at the waist and with little round visorless caps with tassels, exquisitely unfitted for the hornyhanded tillers of the soil."† The costume of the women was usually short skirts or knickerbockers, broad-brimmed hats, and flowing hair.

Hawthorne's early novel, *Blithedale Romance*, was based on his experiences at Brook Farm, and there was much discussion by the members as to which of them was the original of certain of his characters.

The sources of income for the Farm were the board of the members, the school tuitions, and the sale of milk and other products of the Farm. The sale of milk did not continue long because as the settlement grew, the boarders needed the entire output. The sale of other farm products never brought in what was expected, as the soil was such as to yield only limited crops. Then, too, many of the members did not prove to be very good farmers. The school, however, was a very successful source of income, and the manufacture of sashes and blinds was also successful.

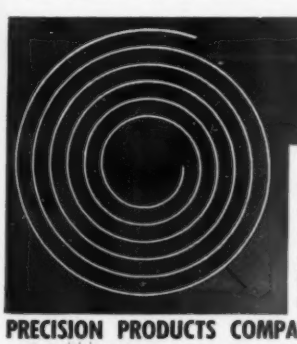
In the course of time Brook Farm became a very popular place for visitors. All sorts of people were liable to drop in to see friends or find out how the experiment was working. They were hospitably received, offered free meals, and often spent the night. This finally became a heavy drain on the finances of the Association, for in one year there were 4,000 visitors. So it became necessary to make a small charge for those who stayed for meals or overnight.

Switch to Fourierism

For a while the experiment at Brook Farm showed promise. True enough, the property was heavily

(Continued on page 162)

† Boston: Houghton Mifflin and Company, 1898.



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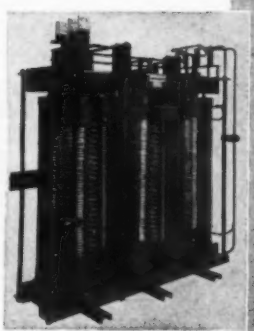
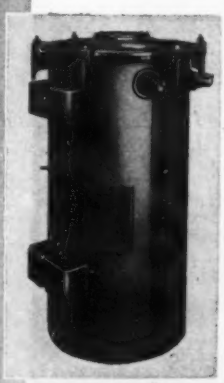
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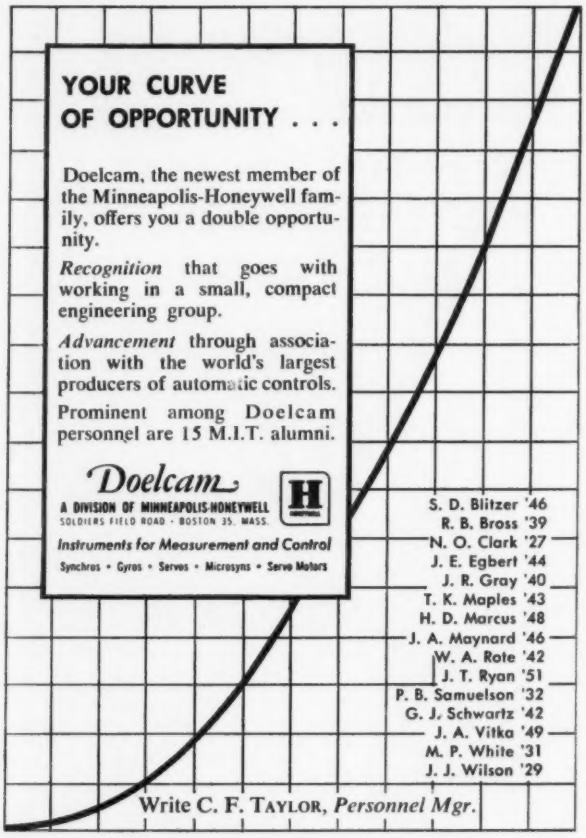
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BROOK FARM

(Continued from page 161)

mortgaged, and in the early years, financial reports showed annual deficits. But the report for the year 1844 showed a balance of $1,160.84. The school was going well. There was harmony and enthusiasm among the Brook Farmers who found health and inspiration in a new way of life in which physical labor, wholesome amusement, intellectual stimulation, and respect for one's fellow man were all happily blended. The Brook Farm community was widely and favorably known, and applications for membership augured well for future growth. But a change came.

Even when written by those who personally took part in the experiment, accounts of Brook Farm do not clearly give reasons for the cause of the change. A clue may be found, however, in an article published in *The Dial* for January, 1844, which states that Brook Farm ". . . is not a community; it is not truly an association; it is merely an aggregation of persons, and lacks the oneness of spirit which is probably useful to make it of deep and lasting value to mankind. It seems, after three years' continuance, uncertain whether it is to be resolved more into an educational or an industrial institution, or into one combined of both."

Might the popularity of the associative movement itself have contributed to the change that took place at Brook Farm? John Thomas Codman, who had spent two and one half pleasant years at Brook Farm, has commented: "Brook Farm was in an exceptionally good position when the associative movement broke out, like a fever, all over the country. It was a new organization. It had started two or three years before the rest. It had fixed itself in the minds of the thinking part of the community as a gathering of able, upright, conscientious men and women."‡

At any rate, after a few years of operation, the time came when the affairs of Brook Farm were in a serious condition and were not improving. Many of the former members had left for various reasons and only six of the original stockholders remained. By 1844 the group numbered 70 residents of which 30 were pupils. There was a good deal of dissatisfaction, and definite plans for the future were earnestly discussed. Should the school be made the principal feature in the settlement? Should the mechanical industries be given more prominence, or was the farm life to be made the main goal?

The leaders were busy studying Fourier's theories which were being vigorously set forth by Albert Brisbane, Park Goodwin, and Horace Greeley in the New York *Times*. Fourier's ideas that industry could be made attractive by organized labor, and that higher standards of work could be achieved were certainly interesting. So were his ideas that there was a sublime destiny for man on this planet; and that all the instincts of our nature, when not subverted by bad

(Continued on page 164)

‡ John Thomas Codman, *Brook Farm – Historic and Personal Memoirs* (Boston: Arena Publishing Company, 1894).

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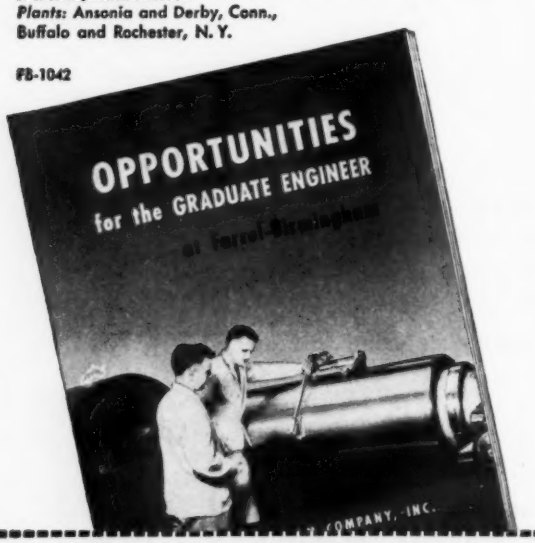

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BROOK FARM

(Continued from page 162)

conditions, point toward that destiny. Labor is the underdog, and it is the unnatural relation of capital and labor that makes the worker what he is, argued the followers of Fourier. Brook Farmers did not favor communism but felt that the laborer personally owned the value of his labor and by mutual consent this might be retained, invested, and added to the labor stock. This they found agreed with Fourier's theories. They also agreed with his ideas of making industry attractive and that the attractions of life are in proportion to the destinies they assist in accomplishing.

So in January, 1844, the directors—consisting of George Ripley, Minot Pratt, and Charles A. Dana,—reported to the members that they proposed a radical and universal reform rather than an effort to redress any particular wrong or to remove the sufferings of any single class of human beings. They asked for the generous and helpful co-operation of all classes for sympathy, encouragement, and aid so that human life shall be developed not in discord and misery but in harmony and joy. Thus did Brook Farm become a phalanx in the Fourier organization.

The Fourier system which was set up required that everything be arranged in groups and series. A group consisted of three or more individuals combining for some object; and three or more groups made a series. For instance, a farming series consisted of a cattle group, a plowing group, a nursery group (having to do with young trees), and a planting group which took care of planting, hoeing, weeding, and haying, according to season. The mechanical series covered shoemaking, carpentering, and blindmaking which were not seasonal. The domestic series covered consistory, dormitory, and kitchen groups. There was also an independent series of teachers, a commercial group, and the sacred legion which did exceptionally disagreeable work from a sense of duty. Each group had a chief who kept a record of the work done by each member.

The change produced a mechanical arrangement which tended to make the members automatons—without much deference to their varied talents, characters, or capabilities. Members however, were, given certain freedoms in selecting their jobs and changing them when desired. In theory the set-up seemed attractive, but in actual development it proved complicated and required a large amount of paper work.

Magazines

The Brook Farm groups were strong believers in publishing a newspaper or magazine, not only to keep their members well informed on the local news and plans of the future but also to serve as propaganda for the purpose of attracting new members. The first magazine, called *The Dial*, was started soon after the Association was formed, and published at the Brook Farm printing plant which was headed by

(Continued on page 166)

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BROOK FARM

(Continued from page 164)

Minot Pratt, an experienced printer. It was well edited and had an exceptional staff of writers. Charles A. Dana was one of the most prominent, and because of his clerical experience he became an unofficial business manager.

When the Association switched to Fourierism and became a phalanx, the publication was continued but was renamed *The Harbinger*. It continued for about four years, being published later in New York. It had a distinguished list of editors and writers, including: Albert Brisbane, William H. Channing, Christopher Cranch, George William Curtis, George Foster, Park Goodwin, Horace Greeley, Osborne MacDaniel, Otis Clapp, W. W. Storey, Thomas Wentworth Higginson, James Russell Lowell, and John G. Whittier. The strictly Brook Farm members were George Ripley, John S. Dwight, Charles A. Dana, and L. K. Rykman. Ripley and Dana wrote most of the editorials in the publication.

It was stated that the publication would be "devoted to the cause of a radical, organic, social reform as essential to the highest development of man's nature to the production of those beautiful and elevated forms of character of which he is capable, and to the diffusion of happiness, excellence, and universal happiness on earth." Moreover, "the principles of universal unity as taught by Charles Fourier in their application to society, we believe, are at the foundation of all genuine social progress, and it will ever be our aim to discuss and defend these principles without any sectarian bigotry and in the catholic and comprehensive spirit of their great discoverer."

The Fire

In 1844 work was started on a large new building, called the Phalanstery, that would house and care for some 150 members and solve the problem of crowded quarters that prevented further growth of the settlement. The Phalanstery was to be a three-story wooden building 175 feet long. It was to contain 100 rooms and have 14 independent houses, each with a parlor and three sleeping rooms. On the lower floor was a large kitchen and dining room holding 400 persons. Upstairs was a chapel (where it was hoped that the Reverend William Henry Channing would preach) and a number of meeting rooms and parlors of smaller size. The estimated cost was about $7,000. Work had continued on the building for two years, as fast as money was collected for the purpose.

In March, 1846, the work was about three-quarters finished. On a Monday evening there was a lively dance in progress in the building known as The Hive. On the previous Saturday the carpenters had installed a stove in the Phalanstery, which they had not worked on during the winter, in order to dry it out and make it comfortable to work in. Did they notice a slight crack in the chimney? Apparently not.

A watchman visited the building about 8:30 and reported everything in proper condition. About 15

minutes later a faint light was seen in the second story. A spark had escaped from the crack in the chimney. The building was soon enveloped in flames. The dancers nearby were notified but at first thought it a joke. An alarm was sounded and fire apparatus from Boston arrived before long, but it was too late. The huge structure could not be saved. The fond hopes of the faithful Associates were suddenly shattered. President Ripley thanked the brave firemen and gave them coffee and food. He also spoke words of cheer to the discouraged members and stated that with cheerful hope he was sure they would be able to continue and do much for the cause they all loved.

Unfortunately his brave hopes were never realized. Conditions did not improve in spite of hard work by the members. The burning of the Phalanstery was too heavy a blow for any easy recovery. In that building centered most of the hopes of the little group. It would have allowed for a large increase in the membership and been a considerable source of income. No insurance had been placed on the unfinished building, and the total loss of $7,000 fell upon the Association. The organization was already at a low ebb financially and this was the last straw. New members were greatly needed and it was almost impossible to get any under present conditions. Instead, the members began to leave. First was Peter Baldwin (nicknamed the General) one of the best loved and most efficient of the workers. He was soon followed by Minot Pratt, one of the original group and a very practical and faithful member who had the respect and confidence of all. Many of the other members became dissastisfied with the outlook and were somewhat in doubt about the soundness of the theory that high-grade literary people could work indefinitely in harmony with mechanics and artisans of a very different upbringing and with different ideals and talents.

Meanwhile a New York group led by Dana and Brisbane had started a branch settlement at Red Bank, N.J. This was near the great markets of New York and had much more productive soil than did Brook Farm. They made a strong effort to have the Brook Farmers leave West Roxbury and join their settlement. At this time the California gold fever was just starting and its influence was strongly felt by some of the Brook Farm members.

Sale of Property

By August, 1847, matters had reached such a crisis that President Ripley was authorized to transfer the entire property to a board of three outsiders — consisting of Theodore Parker, George Russell, and Samuel Teele. In 1849 it was sold to John C. Plummer for $19,000, to be used by the Roxbury Alms House. In 1855 it was sold to the Reverend James Freeman Clark who in turn sold it to Mrs. James W. Monroe. A little later, in 1870, it was sold to the present owners, the Lutheran Association, for Works of Mercy.

(*Concluded on page 168*)

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BROOK FARM

(Concluded from page 167)

The members gradually drifted away, most of them to their former jobs. George Ripley lost his fortune in the Brook Farm experiment and left it a poor man. He and his wife went to live in Flatbush, N.Y., and continued to work for *The Harbinger* for awhile. He also did some work for the *Tribune* which brought him only $4.00 to $5.00 a week. Later he found more remunerative jobs, including that of associate editor of the *New American Cyclopaedia*. His wife was fairly successful in finding students for her lessons in French and Italian.

Ripley had promised to be responsible for the debts of Brook Farm, and after years of economy and careful saving he was able to pay off the last of the Association's debts. He died in 1880.

Conclusions

By those who had taken part in the experiment, the decline of Brook Farm was cause for regret but not for admission of failure. Whatever feelings the experiment might have generated in its participants, Brook Farm can hardly lay claim to success when examined by objective, dispassionate eyes. Yet in many respects it possessed almost ideal qualifications for a successful socialistic venture.

The members of the Association – and especially the leaders – were highly intellectual, well-educated persons of considerable integrity. They were imbued with the soundness of their ideas, and willing to make sacrifices to see their objectives fulfilled. They were a congenial, harmonious group who evidently derived much satisfaction from their community mode of life and close associations with one another.

To what, then, is the failure of Brook Farm to be attributed? Financial worries were a constant plague; there was never enough capital, the business ventures undertaken were not very profitable, and income from new members did not come up to expectations. In addition, the crowded conditions of the dormitories prevented acceptance of sufficient numbers of new members as might have overcome financial troubles. It has also been charged that many of the leaders were too much interested in the literary side of the work, and that they lost the keen interest they initially had in the project. Perhaps all these things are true.

But what is to be said of the dozens of other socialistic settlements of that period which lasted but a short time – mostly not more than six or seven years at most? Do the same criticisms apply or must we search for more subtle, more fundamental reasons for their failure? Did not the Pilgrims who first landed at Plymouth find it imperative to give up a communal form of government after but a year's trial? Are the socialistic and communistic communities of today any more successful than their ancestors? Do they not appear to succeed solely by application of terrorism, intimidation, and force? In a world of human beings is it normal – indeed, is it possible – to achieve a higher and more desirable way of life by removing incentives toward individual advancement? Can progress come by trying to level all mankind to a given norm; by fostering conformity and stifling individualism?

These are questions to which the reader must supply his own answers. But the experiment of Brook Farm – and of the many similar communities that have also fallen by the wayside – seems to point a moral.

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(Concluded from page 140)

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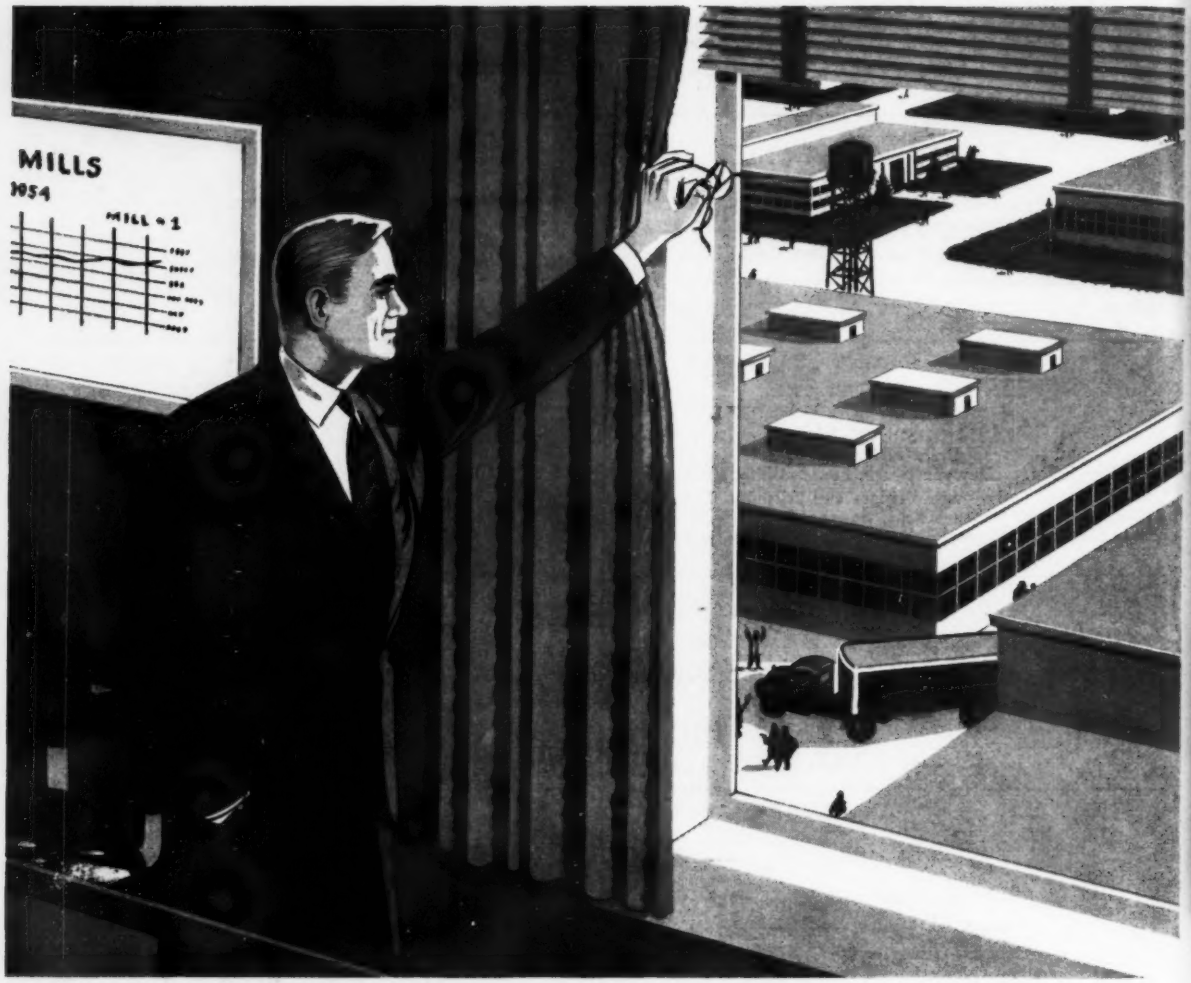

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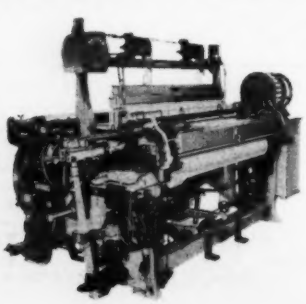

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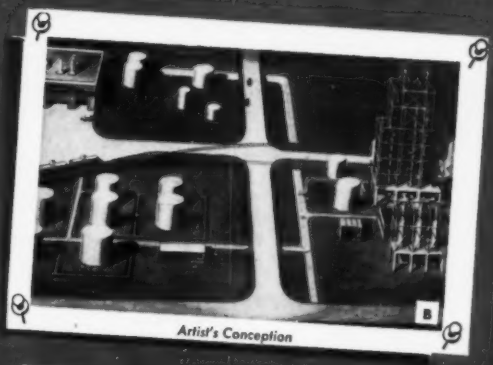

Artist's Conception

CURRENT CHEMICAL PROJECTS

Shown above are just a few of the current Lummus chemical projects.

A Lummus-designed anhydrous ammonia, sulfuric acid and ammonium sulfate plant under construction for Gonzalez Chemical Industries, Inc., at Guanica, Puerto Rico.

B 30,000,000 lb/yr vinyl acetate plant engineered and constructed by Lummus for Air Reduction Chemical Company to come on stream at Calvert City in early 1956.

C First commercial installation in this country for manufacture of high pressure acetylene derivatives engineered and constructed by Lummus for General Aniline & Film Corporation to begin operations at Calvert City in late 1955.

D Phenol-Acetone plant designed, engineered and constructed for Progil-Electrochimie at Pont de Claix, France in 1955.

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OTHER CURRENT LUMMUS CHEMICAL PROJECTS

1. 60-ton/day anhydrous ammonia plant being engineered and constructed for Westvaco Chemical Division, Food Machinery & Chemical Corporation.
2. Carthage Hydrocol, now owned by Stanolind Oil & Gas Co., being redesigned and reconstructed by Lummus for manufacture of synthetic fuel and chemical raw materials from natural gas.
3. Phthalic anhydride plant for Pittsburgh Coke & Chemical Company to be built at Neville Island, Pa.
4. Lummus-designed ammonia plant for St. Paul Ammonia Products, Inc., to be built at Pine Bend, Minnesota.
5. Epon Resin units for Shell Chemical Corporation at Houston, Texas.
6. Bisphenol unit for Shell Chemical Corporation at Houston, Texas.
7. Tetramer, Cumene and Phenol-Acetone units for Societe des Chimiques des Derives du Petrole at Antwerp, Belgium.
8. Sulfuric Acid plant for Inland Chemicals Canada Limited at Fort Saskatchewan, Alberta.

STROBOTAC® and Variac® MOTOR SPEED CONTROL

Team up at BULOVA Research Laboratories

The wearing qualities of journal bearings with nylon sleeves are being tested by an engineer of the Bulova Research Laboratories. These measurements are performed under different load conditions and with various shaft materials to determine bearing heating, wear and failure. Since speed is an important factor on which these characteristics are dependent, it is essential that speed be controlled accurately. The motor actuator must be capable of providing the widest range of speeds and, once set, the speed must not vary. There must be no torque pulsations to affect measurements adversely.

Photo Courtesy of Bulova Research

In the G-R Variac Motor Speed Control, the Bulova engineer has a motor drive which easily meets these specifications and provides much more in addition. This device plugs into ordinary 115-v or 230-v lines, converts this power to dc, and makes available all the advantages of d-c motor operation.

Infinite Speed Control, inherent in the design, permits setting at *any* speed from a few rpm to rated speed. *Dynamic Braking* enables *instant* stopping and reversing, permitting the engineer to study the effects of sudden speed changes on bearing life. *Overload Protection* prevents motor burnout when the bearings "seize". *Selenium Rectifiers* for a-c rectification (there are no electron tubes) require no warm-up time and make the Variac Motor Speed Control rugged and dependable in operation. Finally, regulation is good and speed control is smooth; there is no "chattering" even at the very low speeds.

Variac Motor Speed Controls are time-tested, highly recommended motor drives available in six ratings from 1/15 to 1½ hp. Prices from $75 to $380 (motors at extra cost). All models come complete and ready for installation by any electrician. The basic elements can be provided in stripped-down form at even lower cost for the manufacturer who wishes to build this versatile Control into his own product or equipment.

The G-R Strobotac is used in these journal-bearing measurements as a stroboscopic tachometer for the accurate measurement of speed. Speed must be known in order to correlate bearing wear with shaft travel. The advantages of stroboscopic light for measuring speeds of rotating, reciprocating, vibrating, and other cyclic movements are well established. There is maximum ease and rapidity of measurement. Since there is no physical connection between Strobotac and the moving object under test, no drag is imposed on the subject. Portability, a built-in calibration system, and operation from ordinary 115-v, 60-cycle power have all contributed to make this device an invaluable industrial tool.

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